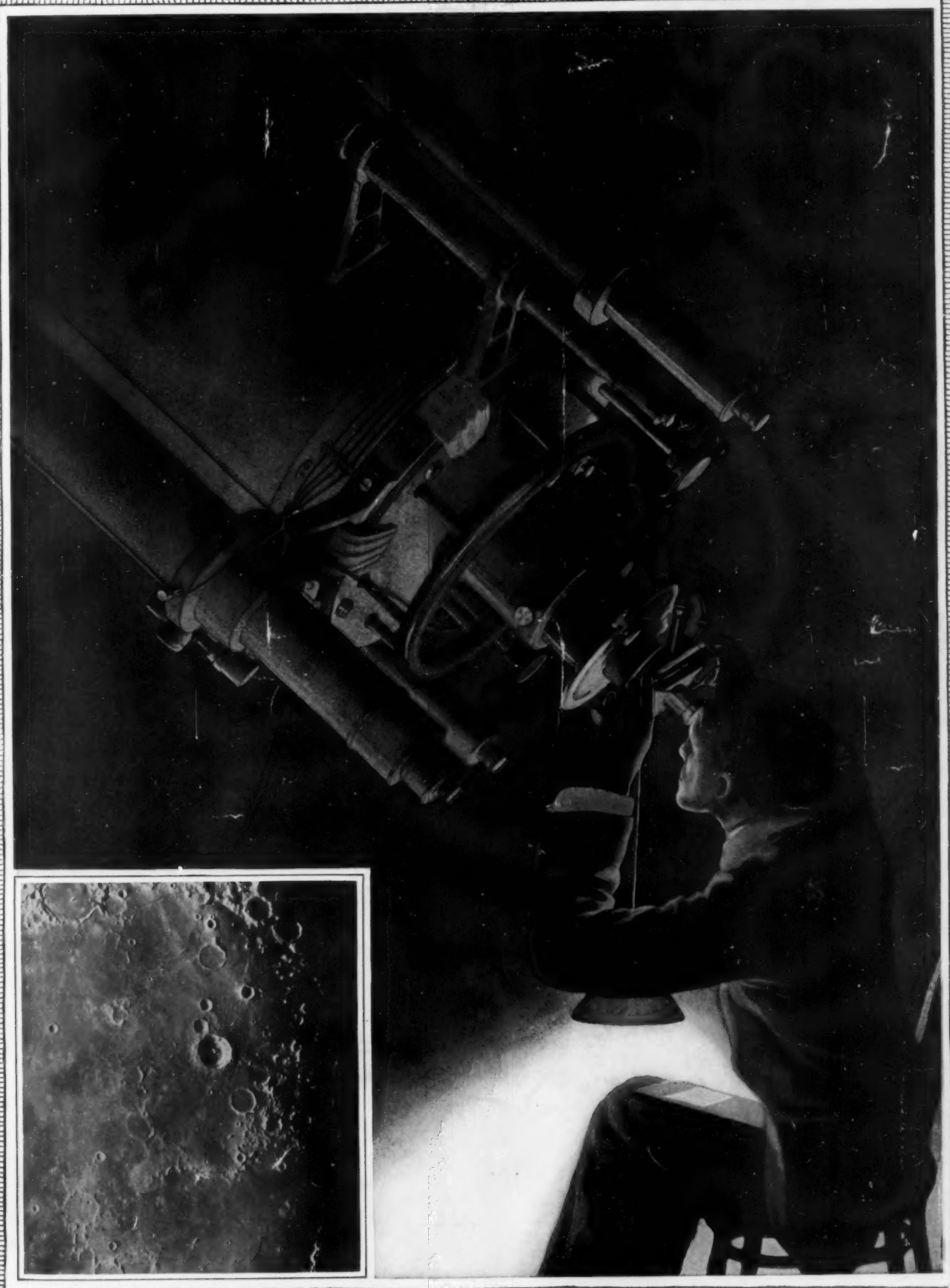
SCIENTIFIC AMERICAN



Vol. CX. No. 14
April 4, 1914

Munn & Co., Inc., Publishers
New York, N. Y.

Price 15 Cents
$3.00 A Year

Packard

SERVICE KEEPS YOUR TRUCKS ON THE JOB

Packard service is based on our knowledge that mechanical delay means unnecessary expense to the truck owner.

The cost of a part may be insignificant, but the cost of an interrupted business schedule is often prohibitive. When a truck is laid up waiting for repair parts, your interest on investment, insurance, driver's wages and garage rent are going on at the same rate, while you pay an excessive charge for emergency hauling.

Delays mean excessive cost that must be added to the first cost of the truck. That is why a truck without service is expensive at any price as compared with a Packard.

Repair parts for Packard vehicles, carried by the Packard factory and Packard dealers, represent an investment of one million, two hundred and fifty thousand dollars.

Packard service means more than keeping repair parts in stock. Every Packard part is ready for quick installation. It is standardized: no filing, no machining, no tinkering. Where a fleet of Packards is in service, the parts are interchangeable in case of need.

The Packard dealer's thorough inspection and written reports insure continuous operation at minimum cost. Our technical men are always ready to give your driver expert assistance.

In short, Packard service makes your transportation schedule a known quantity.

Every time you see a Packard truck, remember Packard service stands ready to keep that truck operating every minute of every working day. Packard service is a part of the truck, a part of your original investment. That is one reason why Packard trucks are predominant in 181 lines of trade.

The Loose-Wiles Biscuit Company, after using Packard trucks for three years, have placed their tenth repeat order which calls for 24 two-ton and three-ton units.

ASK THE MAN WHO OWNS ONE

CHASSIS F. O. B. DETROIT

2-Ton	$2800	4-Ton	$3550
3-Ton	$3400	5-Ton	$4150
		6-Ton	$4300

PACKARD MOTOR CAR CO., DETROIT

LINCOLN HIGHWAY CONTRIBUTOR

DELCO

ELECTRIC CRANKING LIGHTING IGNITION

One of the foundation stones on which Delco Success has been built, is the Delco Ignition.

Very early in their experimental work Delco Engineers recognized the important part that ignition plays in the operation of any automobile starter.

They realized that without an ignition system that was absolutely right and dependable, no starting device could be successful.

So it was that in the development of an efficient starting and lighting equipment for automobiles the production of a thoroughly efficient ignition was the logical and necessary first step.

That was away back in 1908.

Delco ignition was of a new and distinctive type. It was contrary to established practice. Naturally it met with opposition and criticism.

But it made good.

It made good during those first few years when it was only an ignition system.

It has even more emphatically demonstrated its efficiency during the last three years as an important part of the Delco system of Electric Cranking, Lighting and Ignition.

And finally—the correctness of the principle upon which it is based has come to be so generally recognized that it is being adopted as fully as patent restrictions will permit by many of the most prominent electrical and automobile engineers in the world.

Delco ignition is simply one factor in the success of the Delco system.

It has shown such high efficiency, however, that not a single automobile manufacturer who has once adopted it has been satisfied to go back to the older types of ignition.

It is not as spectacular in its performances as the cranking or even the lighting, but in its quiet, effective way it has played an important part in the revolutionizing of the automobile industry.

You will find the Delco system of cranking, lighting and ignition today on more than 90,000 motor cars and this number is being added to at the rate of over 8,000 a month.

There is a tremendous and steadily increasing demand among thoughtful buyers for Delco equipped cars.

Be sure to write for the Delco book mentioned below

The Dayton Engineering Laboratories Company

Dayton, Ohio

SEVENTIETH YEAR

SCIENTIFIC AMERICAN

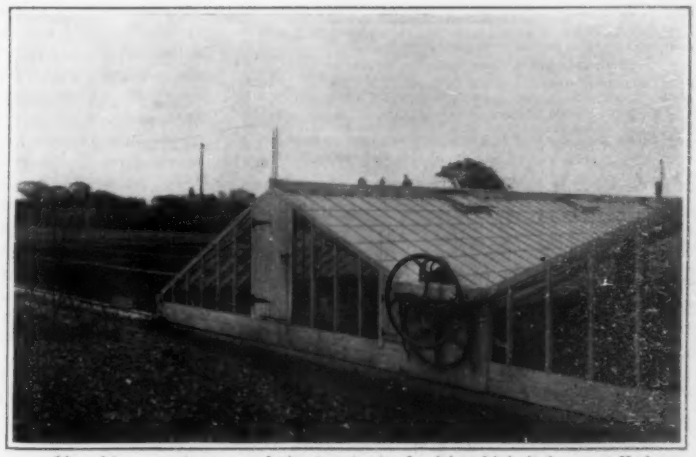
THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CX. NUMBER 14.

NEW YORK, APRIL 4, 1914.

15 CENTS A COPY $3.00 A YEAR

The apparatus by means of which the greenhouses are moved.



Movable greenhouse and the hand-wheel with which it is propelled.

Traveling Greenhouses

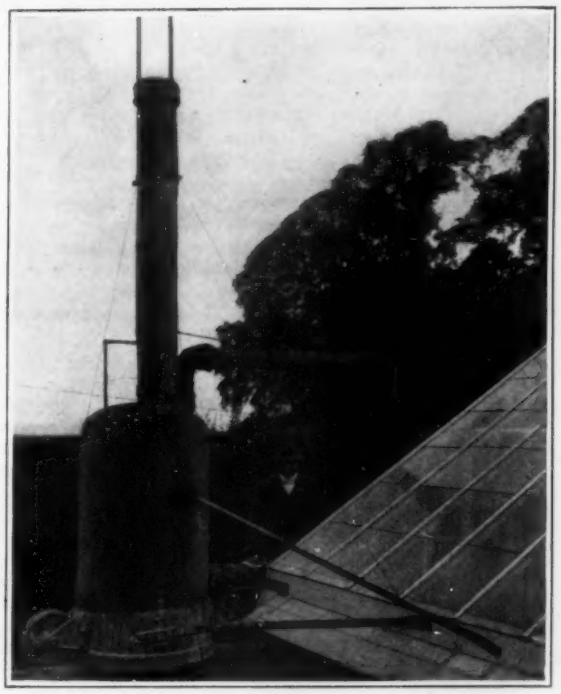
By S. Leonard Bastin

A VERY interesting development in the horticultural world has been the coming of the movable glass-house. In almost all temperate regions, there are occasions when crops of many kinds benefit enormously if a temporary protection of some kind can be given to them. Mr. J. Pullen-Burry of Sompting, near Worthing, England, has at last solved the difficulty by the introduction of his traveling greenhouse, which can be conveyed from different points of the ground to the situation where it will be most useful.

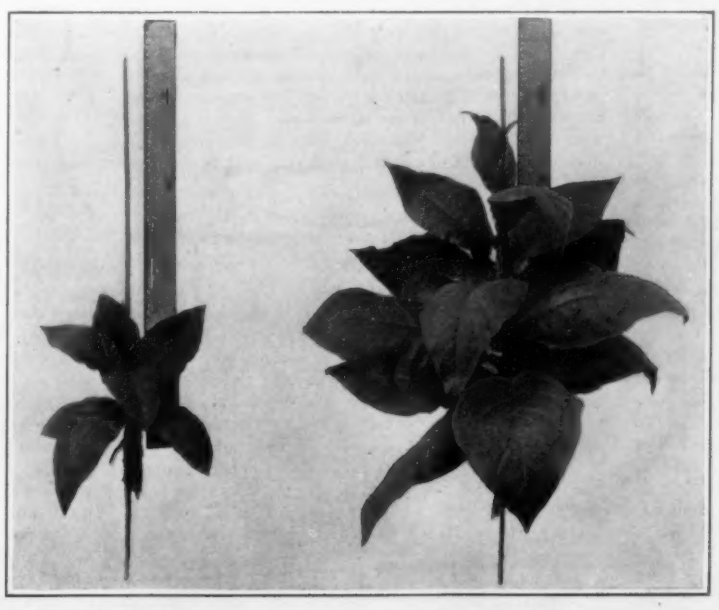
During the last few years there have been many efforts to establish the culture of the tobacco plant in Great Britain and Ireland. The variable nature of the climate of the United Kingdom has very much hampered these undertakings. In particular, it may be mentioned that during the last fortnight of its growth the tobacco plants have suffered very much from the effects of low temperature. The foliage has failed to ripen properly, with the result that often enough, a most promising crop has finally turned out to be almost a failure. Some kind of protection is also to be desired in the early summer. Between these two periods the tobacco plant is quite at home in almost any part of England or Ireland. There is no need, and it would of course be very expensive, to have the tobacco crops under glass the whole time. It is just here that the traveling greenhouses are so useful. These are moved over the crops of tobacco at critical times, and for the remaining parts of the season they are used in connection with different crops altogether.

A glance at the accompanying photographs will show the nature of the movable glass-house. A typical house is 100 feet in length, and 14 feet in width. It is fully equipped with a boiler and heating apparatus. Although the structure is estimated to weigh about twenty tons, it can be readily controlled by one man. By simply turning a handle the wheels travel along a concrete way, from which they are prevented from slipping off by a guard rail. The heating apparatus of course goes with the house, and experiments have shown that the whole business of transfer does not take more than about twenty minutes. The question of cost, which is of course a matter of importance, has been carefully worked out, and it is demonstrated that a movable hothouse does not involve more than 20 per cent increase in the expenditure which would be incurred for the ordinary type.

The importance to the horticultural world of this new invention can hardly be overestimated. Many kinds of market-garden crops only require protection during the first stages of their growth. If this can be provided there will be a very much earlier gathering. Yet the actual time which they need spend under glass would only be about two or three weeks. Hence it is not always worth while planting them in a greenhouse. Under the movable greenhouse system the crops can be given just as much protection as is necessary, and afterward the glass-house is employed for something else. Thus an enormous saving is effected in all ways.



Movable boiler from which the hot water supply is secured.



Grown in the open. Grown under glass.

How the tobacco plant thrives under the movable greenhouse.

Softening Souple Silk

RAW silk is of three kinds, known to the trade as organzine, tram, and souple. The organzine is used for the warp of woven materials, and the tram for the weft. Before these are dyed and prepared for weaving, the silkworm gum must be washed out by a process called "stripping." The souple silk is used for the manufacture of the soft fabrics, such as messaline, chiffon, etc., and in order that these materials may retain their softness and pliability and admit of being crushed in the hand without showing any signs of creasing, the souple silk must first undergo a process known as softening.

This process is a very delicate operation, and the quality of the silk depends very much upon the care with which the softening is done. In this case the silk is not stripped of the silkworm gum, but is immediately placed in a bath of pure olive oil soap. This bath is made up of about fifty parts of pure water to one of strong liquid soap. The silk is suspended in this bath on wooden rods, and is moved back and forth by two operatives who frequently turn it and keep it in constant motion. The bath is heated to 30 deg. R., and owing to the continuous agitation of the silk in the bath, the silkworm gum, while not washed out, is made to permeate uniformly throughout the silk.

After being treated in this manner for about an hour the silk is removed and placed in another bath of lukewarm water where it is again treated in the same way. This process continues for about fifteen minutes, and is intended only to cleanse the silk. The skeins are then removed from this bath and placed in another consisting of about sixty parts of pure water to one of concentrated sulphuric acid heated to 60 deg. R. Here it is worked back and forth, and frequently turned very slowly for about two hours, or until it yields very readily to a pressure of the finger. It is then removed and given two thorough washings in cold water. It is then ready for the dyeing.

One of the Largest Forest Nurseries in the United States is conducted by the forest service near Haugen, Montana. It is known as the Savenac nursery, and has a capacity of four million young trees a year.

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, APRIL 4, 1914

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

Subscription Rates

Subscription one year $4.00
Postage prepaid in United States and possessions. Mexico, Cuba, and Panama
Subscriptions for Foreign Countries, one year, postage prepaid. 4.50
Subscriptions for Canada, one year, postage prepaid 5.75

The Scientific American Publications

Scientific American (established 1845) ..... per year. $3.00
Scientific American Supplement established 1876. " " 5.00
American Homes and Gardens ..... " " 3.00

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application
Remit by postal or express money order, bank draft or check

Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Redemption of Mesopotamia

THERE is a romantic as well as an historical interest attaching to the great irrigation works which are being carried on in ancient Mesopotamia with the object of restoring to that historic and richly fabled country something of its one-time fertility. Like much of the land in what was once known as the great American desert, the soil and climate of the valley of the Euphrates are such that if water is supplied, it shows a wonderful productiveness. In earlier times the inhabitants planned and built a system of dams and canals, the remains of which show no little engineering skill; and it is only because of abuse and neglect that the dams have broken down, the canals have silted up, and this once productive land has been transformed into noisome swampland or arid desert.

The Turkish government, prompted no doubt by the excellent results which have been achieved in the valley of the Nile, in 1909 authorized Sir William Willcocks to visit Mesopotamia and report upon the feasibility of constructing a new system of irrigation works. In a report published in the following year, Sir William proposed an elaborate scheme of dams, canals, and other accessory works, the total cost of which was estimated at $75,000,000. The Turkish government decided to carry through the scheme in sections, and it authorized the immediate construction of a dam across the Euphrates at such a point as would serve to divert a supply of water to an ancient canal known as the Hilla Channel, which formerly supplied water for the irrigation of a large tract of land extending almost to the ruins of the ancient city of Babylon.

The ancient work consisted of a dam across the Euphrates which raised the level of the river sufficiently to pass the desired amount of water down the old Hilla Branch channel. The work had so far gone to ruin that the Hilla Branch had silted up and the country which it formerly served so well had reverted to the desert condition. It is interesting to note that the site chosen for the new dam is an endorsement of the wisdom of the early engineers; for the new structure is only about 2,500 feet upstream from the old structure. The difficulties of construction were increased by the lack of transportation and the absence of fuel. Nevertheless, in less than three years' time, the original channel of the river was closed by a dam, a barrage seven hundred and eight feet in length provided with the necessary regulating gates was constructed, the Euphrates was diverted from its old channel and made to flow through the barrage, and a new diversion was cut from the Euphrates above the barrage to a connection with the old Hilla Branch. The barrage has thirty-six openings each sixteen and one half feet in width. The piers are built of brickwork and the openings are provided with the usual Stoney sluices. At one side of the barrage is a lock 26 feet 3 inches wide, and 320 feet long, provided with a pair of gates in the center which divides it into two parts. After the barrage was completed, the ground above and below it was excavated, the new channel for the river, 815 feet wide, was formed, and the river was made to pass through the barrage by way of this channel. According to *The Engineer*, to which we are indebted for the above facts, there has been built, also, what is known as the Habbania Escape, by which the waters of the Euphrates, when the river is in flood, may be diverted partly into a lake and partly into a large natural depression in the ground. This will serve to prevent, or at least mitigate, the inundations which in times of flood have converted large sections of the adjacent country into morasses.

New York's Sewage Problem

TWO of the most important problems directly affecting the health of a great city—some will be prepared to say that they are absolutely the most important—are those of the provision of an abundant supply of drinking water and of the proper disposal of the sewage. At a cost of nearly $180,000,000, New York city has solved the first problem by a remarkably fine system of works by which an entirely new supply of 500,000,000 gallons of pure mountain water will be brought daily from the Catskill Mountains and distributed throughout the city. With respect to this water supply, New York can be said to be fully abreast of the latest practice.

But when we come to the question of sewage disposal, the situation is simply appalling; for day by day this city is discharging into the waters with which it is surrounded, every gallon of the liquid refuse that it daily produces. This has been done under the mistaken belief that since the waters of New York harbor are subject to tidal flow, the sewage is diluted, carried away and lost in the broad Atlantic. As a matter of fact, nothing of the kind occurs. On the contrary, the solids, held for a while in suspension, are carried to and fro with the ebb and flow of the tide and are finally deposited in an ever accumulating mass of filth covering the bottom of the harbor; and a very large proportion of it is deposited closely adjacent to the shore line and between the steamship piers.

Hence it follows that the investigation which has been carried out by the Metropolitan Sewerage Commission is one of the most important affecting the public health that has taken place in all the history of New York. This commission recently submitted a statement to the mayor, in which it was said that New York city is thirty years behind the times in the matter of sewerage and sewage disposal. Accompanying this statement was one by X. H. Goodnough, the engineer of the Massachusetts State Board of Health; and from these documents we learn that whereas the sewage of New York is discharged into the harbor without system or regulation, with results which produce serious injury to the public health and welfare, Boston and the harbor are protected from pollution by main drainage works which serve not only that city, but also a large number of cities and towns in its vicinity.

The Boston situation is capable of furnishing an instructive object lesson to New York city; for up to a certain point the experience of the two cities has been remarkably alike. The conditions which led to the construction of the Boston works were like those which exist at the present time in New York. The sewage caused odors and sludge deposits, and, although it was impossible to trace individual cases of disease to the polluted water, physicians declared that no fact was better established than that foul air was unfavorable to health, and that extended changes in the sewerage system could alone accomplish practical good. The sewage disposal works of Boston consist of three ocean outlets to which the sewage, to the extent of about 200 million gallons per day, is taken for screening and settlement and ultimate discharge.

The members of the Metropolitan Sewerage Commission have visited the Boston harbor, and the commission's floating laboratory which was sent there made over one hundred analyses of the water. The water, except in the immediate vicinity of the three outfalls, was of excellent quality. Whereas the average amount of oxygen found in Boston harbor was generally over 90 per cent, it has often fallen below 20 per cent in New York harbor. Comment on this comparison as showing the harmful conditions at New York is unnecessary.

Contracted Computations—Dogma or Scientific Efficiency?

SCIENCE as taught at college is not free from the dogmatic element, and the man who has the college gates well behind him is apt still to trail after him a certain amount of more or less age-worn dogma. Indeed, it sometimes requires a certain temerity to attack precepts to which weight and dignity is added by good authority—this perhaps is one reason why so little question has ever been raised with regard to the propriety of the teaching: "Carry every computation only just to so many significant figures as the accuracy of the data warrants. Anything beyond this," says the teacher, "is waste of time and energy, and gives a spurious appearance of precision."

This looks very plausible at first sight, but the teacher seems to have overlooked the fact that a certain amount—sometimes a considerable amount—of energy must be spent in determining just how many figures must be retained, at a minimum, in order to obtain the result with that degree of precision which the data permit. We quote from a book review in *Nature:*

"We venture to question whether teachers do well in this matter. It is customary to work to a significant figure more than will be required in the result; this generally gives the result to the required approximation, but not always. Are we to chance the accuracy, or are we to complicate the process further by an estimate of the trustworthiness of the result? Moreover, the estimation of the number of figures to be retained, even in the normal case, is a matter of no little skill; we have frequently known professors and schoolmasters of good standing to be at fault.

"There appears to be no educational principle at stake, and the question is simply whether contracted methods conduce to speed and accuracy or not. Does the shortness of the contracted calculation compensate for the time spent in deciding how far to contract, and for the chance of error by excessive contraction? For the expert calculator, like the teacher of arithmetic or the observatory computer, it compensates without doubt. For ourselves, and we imagine for most people (adults and children), contracted methods in their strict form do not compensate. For us the best way is to calculate stolidly through, and at the end throw away the unnecessary figures, or if the numbers get very heavy, to contract to a modified extent, keeping, perhaps, two or three more figures than a strict contractionist would allow."

Perhaps in this as in most other practical matters, no hard and fast lines can be laid down, and much must be left to the judgment of the individual.

Solar Radiation Measurements at Great Altitudes

THE problem of eliminating the effect of absorption by the earth's atmosphere in determinations of the solar constant of radiation has never been solved in an entirely satisfactory manner. The ideal solution would be to expose the measuring apparatus above the utmost limit of the atmosphere, and, although this is impossible, an approximation thereto consists in sending up a pyrheliometer attached to a balloon to the greatest height attainable. The first attempts to carry out such a plan were made last summer by the Smithsonian Institution, in co-operation with the United States Weather Bureau. A modified form of the silver-disk pyrheliometer was used. As it could not be kept pointed at the sun, the disk was placed horizontally, and the thermometer was contrived to record its temperature by photography on a moving drum. The disk was alternately exposed to the sun and shaded by the action of a shutter, moved by clockwork. Although in five ascents, on successive days, altitudes up to 20½ miles were attained, the freezing of the mercury in the thermometer unfortunately prevented records from being made above about eight miles. Mr. C. G. Abbot, under whose direction these observations were made, states that "all the measurements unite in indicating values of the solar radiation at altitudes of 10,000 meters (6.2 miles) and higher which fall below the value of the solar constant of radiation as obtained by other methods;" a very interesting result, despite the fact that this method is somewhat rough as compared with pyrheliometric measurements at the earth's surface. This year it is proposed to repeat the experiment with improved apparatus, which will include, *inter alia*, an electrical heating device to prevent the mercury in the thermometer from freezing. Mr. Abbot hopes to reach altitudes up to 40,000 meters (nearly 25 miles), at which the atmosphere is so exceedingly tenuous that the observations, if successful, should indicate very nearly the true value of the solar constant.

Defining the Cyclecar

THE fog that has obscured the exact meaning of the word *cyclecar*, as applied to that type of vehicle which is neither motorcycle nor full-sized automobile, is in a fair way to being dissipated. Ever since the cyclecar first appeared, the question of its proper classification with regard to other vehicles has been a moot one. Now, however, the Cyclecar Manufacturers' Association, but recently formed and representative of the majority of American manufacturers, has set its stamp of approval upon a specific definition; places vehicles other than full sized automobiles and motorcycles in three distinct classes, the first class including cyclecars, the second class slightly larger vehicles which are arbitrarily styled light cars, and the third class still larger vehicles which are to be known as small cars. According to the definition, a cyclecar is a vehicle having one engine of not more than 70 cubic inches piston displacement, the vehicle to weigh less than 750 pounds. A light car is described as a vehicle having one engine of from 70 to 100 cubic inches piston displacement and weighing between 750 and 950 pounds; and a small car is a vehicle having an engine with between 100 and 175 cubic inches piston displacement and weighing between 950 and 1,150 pounds. There are no other restrictions or limitations. Doubtless, the definition of these vehicles, which all heretofore have gone under the generic term cyclecar, will serve at least to slow the flood of inquiries with which the automobile industry and all connected with it have been inundated.

Science

Automatic Pianos have been installed on the restaurant cars of one of the principal railways in Argentina.

Exploration of the Brahmaputra.—According to the *Scottish Geographical Magazine*, Captains Bailey and Morshead have returned to India after an arduous journey in the dangerous country of the Abors, and announce that they have conclusively proved the Tsangpo and the Brahmaputra to be one river, thus settling one of the most interesting of geographical questions. At the same time they bring the surprising news that the supposed falls of the Tsangpo do not exist.

The Sootfall of Pittsburgh, as determined from careful measurements during the past year, ranges from 595 to 1,950 tons per square mile per annum. The destructive possibilities of this immense deposit may be illustrated by stating that if an equal amount of lampblack were ground with oil so as to form black paint it would cover from 17 to 57 square miles with two coats. Statistics of sootfall at certain places in Great Britain are as follows: Industrial section of Leeds, 529 tons; center of London, 426 tons; Glasgow, 820 tons.

Upper-Air Observations in India.—At the instance of the Royal Society, the meteorological service of India is about to embark on a campaign of investigations of the upper air which is expected to extend over a period of ten years. The headquarters of this work will be at Agra, where sounding-balloons carrying registering apparatus will be sent up about twice a week to the greatest heights attainable. There will probably also be four or five sub-stations, from which similar balloons will be sent up to moderate heights; say about 12,000 feet.

Scientific Balloon Ascents by human beings have, to a large extent, been rendered superfluous by the invention of automatic devices for registering the temperature, pressure, etc., at great altitudes; nevertheless, there are still many kinds of scientific observations in the upper air for which a personal observer is essential. A notable series of 16 manned-balloon ascents for the investigation of a wide range of problems has recently been executed at Halle, Germany, some of them to great altitudes (30,922 feet in one case). In one of these ascents, radiotelegraphic apparatus was carried in the balloon, and studies were made of the audibility of wireless signals at different altitudes. In others, specimens of air were collected for analysis up to 29,850 feet; the physiological effects of great altitudes were investigated; and measurements of electrical potential gradient and conductivity of the air were made up to 27,887 feet—an altitude greater than that at which any measurements of atmospheric electricity have ever before been made.

The Kara Sea Route to Siberia was the subject of an address delivered by Dr. Fridtjof Nansen before the Imperial Russian Geographical Society on his return to Europe, after making a journey to the Yenisei on the steamship "Correct." The speaker urged the Russian government to establish a wireless station at Dickson Harbor, at the mouth of the Yenisei, in addition to the three that have been established at the entrances to the Kara Sea. He also recommended that a small fleet of sailing vessels with auxiliary motors maintain an ice patrol in the Kara Sea during the season of navigation, reporting their observations by wireless to the land radio stations, and that this service be further supplemented by means of aeroplanes. It is understood that these recommendations will be carried out by the government, and that a subsidy will be paid to the firm making the most satisfactory arrangements for regular steamship service between a port on the Baltic Sea and the mouths of the Ob and the Yenisei. The vessels must fly the Russian flag, and give preferential rates to Russian goods.

A "Greenwich Time" Monument in France.—On March 11th, 1911, standard time of the meridian of Greenwich was adopted for official and railway purposes in France, in place of standard time of the meridian of Paris. Funds are now being raised to erect a "monument de l'heure" at the point where the Greenwich meridian intersects the northern coast of France; viz, at the seaside resort of Villers-sur-Mer (department of Calvados). A model of the proposed monument, designed by the sculptor Leduc, was exhibited at the Salon of 1913: Phœbus in his car, drawn by fiery steeds, holds aloft a lance with which he points out the standard meridian, while the Gallic cock, surmounting a terrestrial globe, is in the act of crowing to announce the hour of noon. The latter feature is an allusion to the fact that the International Time Conference of last October selected the wireless station on the Eiffel Tower as the central official time-piece of the world. Writing in the *Comptes Rendus*, M. L. Lecornu calls attention to the coincidence that the location chosen for the monument is very near the port of Dives, from which William the Conqueror sailed for England, thus recalling the historical connection between Normandy and Great Britain, and is also not far from the birthplace of the great astronomer Laplace. Lastly, the date on which the new time was adopted in France was the centenary of Leverrier.

Astronomy

Partial Eclipse of the Sun.—Those who live north of a line drawn from Washington to Indianapolis will be able to see a partial eclipse of the sun, if clouds do not intervene, at sunrise on April 21st. The path of totality of this eclipse will be north of 70 degrees latitude and will cross Sweden and southwestern Russia. The United States Naval Observatory has issued full calculations and maps of the eclipse. Since the observatories at Riga and Kief are in the path, it is not likely that any extensive expeditions will be sent out.

Globular Masses.—By studying the distribution of stars in the globular masses 10 Centaur, 47 Toucar and 13 Messier, E. Pickering has deduced, from observation, the apparent density, i. e., the number of stars per unit of surface at different distances from the center of the mass; he concludes that the distribution is the same for bright stars as for feeble ones, and also that the law of distribution is the same from one mass to another. H. von Zeipel has endeavored to deduce, from the apparent density on the celestial sphere, the true density in space, with partially satisfactory results. The distribution of stars near the center was represented in a satisfactory manner, but the density at the boundaries is less than that required by the theory. In a new memoir he arrives at a novel conclusion. Each of these masses is a gigantic system containing about a million stars; the number of stars visible on a plate is not the hundredth part of the total number.

Absorption of Gravitation.—Dr. Bottlinger, of Munich, has made a very interesting attempt to show that gravitation is absorbed in traversing a medium, so that the interposition of a third body between two others affects their mutual attraction. He is of the opinion that the attraction of the Sun on the Moon is enfeebled when the Earth comes between them, i. e., when there is an eclipse and it is to be remarked that the effects of two consecutive eclipses nearly destroy one another. Dr. Bottlinger admits that the enfeeblement of gravitation depends on the density of the medium traversed and is, therefore, obliged to construct an hypothesis respecting the interior constitution of the Earth. The perturbations of longitude, calculated in this way, from 1834 to 1909, are translated into a feeble oscillation of which the period is nineteen years. The epochs of maximum and minimum correspond exactly to those which have been found empirically by Newcomb. It remains to be seen whether the application to a longer interval of time will not show that on this theory we reach results which are irreconcilable with the facts.

Luminosity of the Sky Near the Sun.—Measurements have been made on the luminosity of the sky in the immediate neighborhood of the Sun. The intensity of this luminosity decreases very rapidly as we leave the edge of the Sun, and to determine the law governing this decrease it is necessary to mark out spaces in the neighborhood of the Sun, to measure their distance from the Sun, and to determine the surface luminosity in comparison to that of the Solar disk. For a certain distance the decrease in luminosity from the edge of the Sun, with a uniformly pure atmosphere, is perfectly continuous and symmetrical on both sides. With equal brightness of the sky, the surface luminosity in the neighborhood of the Sun depends on the height of the Sun; it diminishes as the height of the Sun increases. For equal heights of the Sun, it diminishes as the blue of the sky is more intense and, in consequence, as the local luminosity, measured by eliminating the rays of the Sun, is feebler. From the existence of certain perturbations in the curve of luminosity, it is proved that halos exist in the immediate vicinity of the Sun. Measures of the relative luminosities of the sky in the neighborhood of the Sun is a very delicate test of the purity of the atmosphere.

Origin of Structures on the Moon's Surface.—In an interesting letter to *Nature*, Mr. Fisher mentions a few explanations which have been given to account for the present appearance of the Moon's surface. It seems very doubtful whether the so-called craters, which are such a marked feature on the Moon, are really of volcanic origin. Dr. Johnston-Lavis writes, "the more I compare the Moon's surface with volcanic vents in different parts of the World, the less I see a resemblance between the two," and "the more does the planetoid and meteorite projectile theory become acceptable." A very interesting theory was outlined some time ago by G. K. Gilbert. He remarks that, if the so-called craters of the Moon were due to the impact of meteors, their form would be, for the most part, elliptical, whereas, in fact, they are circular. His own theory is that the Earth was at one time attended by a ring similar to that which encircles the planet Saturn, and that this afterward "gradually coalesced, gathering first around a large number of nuclei, and finally all uniting in a single sphere," the Moon. Mr. Fisher suggests that in the disruption of the Moon from the Earth, the material was scattered and that the circular so-called craters have been caused by the impact of fragments of the solid crust and that the mountains of the Moon are angular portions of the Earth's crust.

Automobile

Number of Electric Cars in Use.—According to statistics which have but recently become available, there are approximately 37,000 electric vehicles in use in the United States. Of this number, about 25,000 are passenger cars, the remainder being commercial vehicles. The city of Chicago, of course, holds the record with 2,850 vehicles. New York is next with 2,000 and Cleveland third with 1,800.

Motor Population of New England.—According to the latest authentic reports there are at present 119,115 motor-driven vehicles, including passenger and freight, in the New England States—Maine, New Hampshire, Massachusetts, Vermont, Rhode Island, and Connecticut. Inasmuch as the combined population of these States is 6,552,681, this means that there is one motor vehicle to every 55 inhabitants. During the past year, the number of vehicles registered in these States has increased by nearly twenty-five per cent. The New England registrations represent about one tenth of the number of cars in the United States.

Peening Instead of Grinding Valves.—By way of eliminating waste of time and the great amount of labor involved in grinding poppet valves to a proper seat, an American company recently has adopted the somewhat novel expedient of peening them to their seats. For the purpose a special type of hard valve is used. It is first accurately reamed, as is the seat, after which it is struck a number of rapid, fairly light blows with a compressed air hammer. The resultant seat is said to afford a better fit than that obtained by grinding and to resist leaks and corrosion longer and the whole operation can be completed in from 20 to 30 seconds—a material saving of time over even the best of previous methods.

Substituting Suction for Magnetism.—A small magnet on a long handle is an excellent thing to have about a motor repair shop for lifting small nuts, bolts, etc., out of obscure places. It is open to the objection, however, that it will serve only for iron or steel articles. To overcome this objection there has just been placed upon the market a somewhat similar device in which suction takes the place of magnetism. The lifter consists of a rubber suction cup at the end of a handle which is hollow and which is connected to the hose leading to an exhaust pump. A small thumb valve affords control and there is a hook for dislodging small articles. The device is intended primarily to lift sheet metal stampings from under die presses but is useful in many other ways.

Cyclecar Popularity Increasing.—The popularity of that little type of automobile which has come to be styled "cyclecar" appears to be increasing, though so far the vehicle has not cut a very wide swath for itself. There are now said to be upward of 30 companies building cyclecars, most of them located in Detroit, though not many cars have appeared on the streets. One feature of the movement which may perhaps have been overlooked in some quarters is that makers appear to be finding a ready sale for their products on the other side of the Atlantic. Several instances are on record of American makers having signed contracts for substantial numbers of cars. One maker, in fact, has just announced the consummation of a British contract for 10,000 cars. In the main, however, American makers are confining their efforts to supplying the American market.

Another New Automobile Motor.—Another new type of automobile motor has been added to the long list of those that may be styled out of the ordinary. And as might have been expected, the newness concerns itself chiefly with the valve system. Instead of having the accepted type of poppet valves, this one has a new kind of sliding valves. Across the top of each cylinder there are transverse cylindrical ports approximately the same diameter as the bore of the cylinder. In each port there is a plug with a space between the plug and the cylinder. In this space there is placed a segmental valve which is reciprocated so as to open and close alternately two ports leading to the intake and exhaust manifold. The segmental valves are operated by push rods and cams. In order to prevent the valves sticking, they are lubricated by pressure. The engine is now undergoing a series of efficiency tests.

For Foot Control of Steering.—Because a motor car operator's hands and arms occasionally become tired through holding the steering wheel for long stretches without rest, a Canton, Ohio, company has perfected an attachment whereby the steering of a vehicle can be controlled with one of the operator's feet, temporarily. The device consists of a formed pedal which is attached to the lower end of the steering column. When the operator's foot is placed upon the pedal it drops a fraction of an inch, thus establishing it in connection with the steering gear. Tilting the foot forward and backward then changes the direction of the steering wheels. When the operator's foot is removed from the pedal it springs up and is thus disconnected, when the steering then is accomplished through the regulation steering wheel. It is pointed out that the apparatus possesses the advantage that it permits the operator to drive with his hands in his pockets during cold weather.

A New Theory of Sunspots

By Dr. E. A. Fath

AT the meeting of the Royal Astronomical Society in London on December 12th last, Prof. H. H. Turner, Savilian Professor of Astronomy in the University of Oxford, presented a new and unique theory of sunspots. The full text of the paper has not yet been received, but Prof. Turner has given the outlines of his theory in the London *Times* of December 13th. At first glance the theory appears to be quite fantastic, nevertheless its author has been of great service in the modern development of astronomy, and whatever he says deserves a respectful hearing.

The outline of the theory is as follows:

It is well known that at times there are many spots visible on the sun, while at others they are few or entirely wanting. Observations extending over many years have shown that the number of spots varies with some regularity, the average period from maximum to maximum being about eleven years. A few years ago Prof. Schuster found evidence of other periods of about five, eight, and thirteen years. While investigating the problem recently Prof. Turner found certain breaks in the sunspot series at about the dates 1766, 1800, 1833, 1866, and 1900. In these years meteor showers known as the Leonids were particularly active. It, therefore, appeared that there might be a connection between these meteors and sunspots.

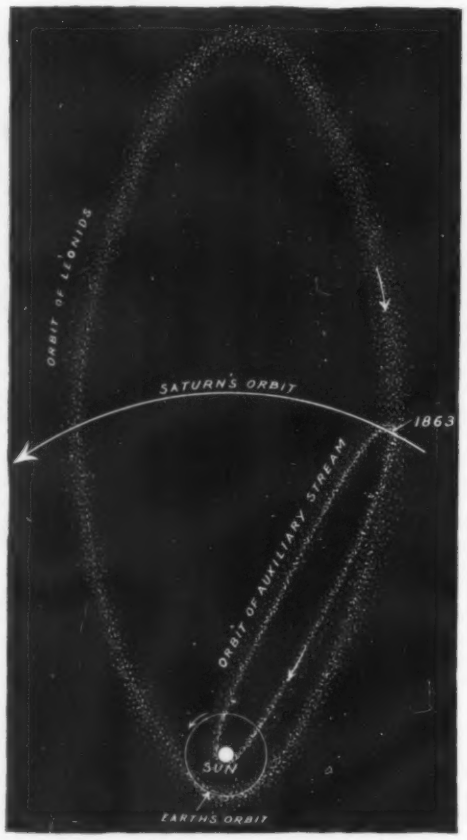
The Leonids themselves are known not to approach very near the sun, and it was therefore impossible to see a direct connection. Some intermediary was therefore required. This intermediary was supposed to be what might be called a subsidiary swarm of meteors which graze the sun at their nearest approach, and also pass so near the orbit of the Leonids that their motion is disturbed by the attraction of the latter when the main swarm of Leonids happens to pass this point.

This subsidiary swarm might have come into existence at a time when the main Leonid swarm was near Saturn. The planet itself probably drew in the larger portion to itself just as the earth draws in shooting stars, but those portions of the swarm which passed through the rings might collide with the components of the latter, and so affect the motion that both meteors and the particles of the rings might be freed from the control of the planet and fall toward the sun. Some would fall directly into the sun and the others would either graze or pass very near the surface of this body.

The dates of the possible encounter of Saturn and the Leonids are given, and, with one exception, these are preceded by a scarcity of sunspots and followed by a marked increase. The last encounter was in 1863. In March of that year a Greenwich observer noted that the inner dusky ring had so increased in brightness that it was nearly as bright as the other rings. This observer therefore may have actually seen the result of the bombardment of Saturn's system by the Leonids. Seven years after this came the great sunspot maximum of 1870. At about this time disturbances in the motion of Saturn in its orbit were noted. If this disturbance was due to the Leonids then the mass of this meteor swarm must be far greater than is usually supposed.

If we can assume that some of these meteors have a large mass, then their fall into the sun must produce a considerable disturbance, for they strike with a velocity of about 400 miles per second. This disturbance manifests itself as a sunspot.

We have thus briefly stated the main points of this latest sunspot theory. It leaves many things unexplained, such as the peculiar distribution of the spots in latitude, why the earth does not encounter huge meteors at times, etc. It may be that the apparent connection of breaks in the sunspot series with the Leonids may be nothing more than a curious coincidence, and it certainly looks as if the author had gone far afield to find a cause which may reside in the sun itself. Nevertheless, before passing judgment on this unique theory, parts of which Prof. Turner himself says have "an appearance of wild speculation," it will be well to await the publication of the complete paper as presented to the Royal Astronomical Society.



Prof. H. H. Turner suggests that there may be a connection between the meteor showers known as the Leonids and sunspots. Some intermediary, however, was required, because the Leonids do not approach the sun—an intermediary found in a subsidiary swarm.

Prof. H. H. Turner's theory of sunspots.

First Magnitude Stars

By Frederic Campbell, Sc.D., Late President Department of Astronomy, Brooklyn Institute

THE world over and the year through, 8,000 stars are visible to the naked eye. Except the five visible planets of our own solar system, all these are suns. Seen through the best telescopes, their number leaps to 100 million; and photography raises it to one million million. So says the distinguished scientist, Sir E. Ray Lankester.

To become familiar with such a host is absolutely hopeless. But, just as we may have a dozen or two familiar acquaintances among the billion and a half people on earth, so is it possible to know a few of the most splendid stars. The most learned astronomer, in fact, carries at his belt but a short string of stellar scalps. The first magnitude stars are but twenty in number; and of these only fifteen are ever visible in our northern latitudes. With these fifteen, or even twenty, splendid luminaries there is no excuse for any man's not having acquaintance, as with so many genial friends.

The first magnitude stars are such as appear the brightest to an observer on earth. The term does not mean their actual magnitude, either their mass, volume or inherent brilliancy. It refers only to the amount of light received from each of them at our terrestrial distance, the way they look, not the way they are. Very huge suns might be so distant or so dull as not even to be visible to the naked eye; and a fifth rate orb might be given rank among stars of the first magnitude, simply because it happens to be located comparatively near our own part of the universe.

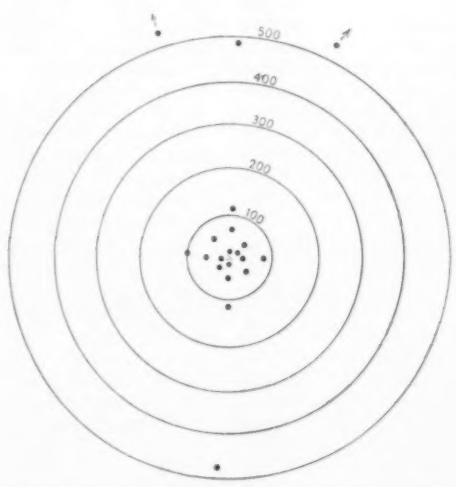
In the table of first magnitude stars furnished herewith, there should be but little difficulty in committing to memory the names in their order, as well as the figures relating to their comparative brilliancy, their distance and their inherent light. If the southern luminaries, never seen in our northern latitudes, be omitted, the task is materially reduced. To know the facts concerning even these few stars is to know little enough concerning the universe, outside of our own miniature earth. One ought to have the ambition to extend his knowledge that far at the very least.

That we may comprehend the facts set before us in the table, a few remarks need to be made. We have already noted that, of the entire twenty, there are five never seen by us who dwell in the north. Of such immense importance are some of these, that it would be a great loss to omit them from our knowledge because they never show above our horizon. One of these is Canopus, next to Sirius in brilliancy, and 2½ times as bright as any other star seen in our north. While, as seen from earth, Canopus is second in the list, giving hardly more than half the glory of Sirius, in itself it is first in brilliancy, radiating an effulgence 10,000 times that of our superb sun. Nor are these figures mere estimates, but the result of scientific light measurements, from which the personal equation has been eliminated. Alpha Centauri, too, another southern star, third in the list, is of immense importance, as being the nearest star to earth that we know. Proximity explains its brilliance, for, in itself, it has the splendor of only two such suns as ours.

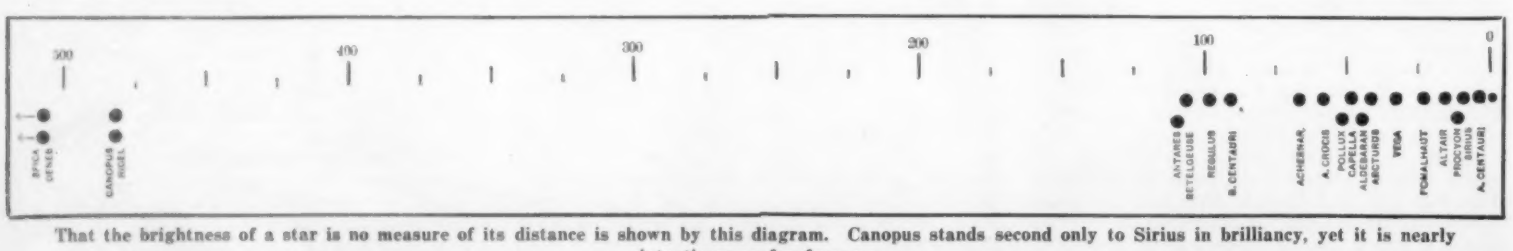
But, viewing the entire group of first magnitude stars, we see in them an illustration of the long-ago-uttered truth that "one star differeth from another star in glory." This is as true, as viewed from earth, as it is in their inherent light-possession. Expressed in terms of magnitude, they run all the way from —1.6 in Sirius to 0.2 in Capella, 1.1 in Aldebaran and 1.3 in Regulus. Or, in comparisons among themselves, they run all the way from Sirius, regarded as 100, to Altair as 10 and Regulus as 7, the latter giving only 0.07 as much light as Sirius, yet grouped in the same class. In the matter of inherent brilliancy or absolute light-giving quality, there are immense differences, running from Alpha Centauri, with a light equal to twice that of our sun, to Altair, equal to 12 suns; to Pollux, equal to 125 suns; to Capella, equal to 300 suns; to Antares, 2,000 suns; Rigel, 4,000 suns; and Canopus, already mentioned as equaling more than 10,000

(Concluded on page 296.)

Distance in light years of the nearer first magnitude stars.



Gap of nearly four hundred light years separates the first magnitude stars.

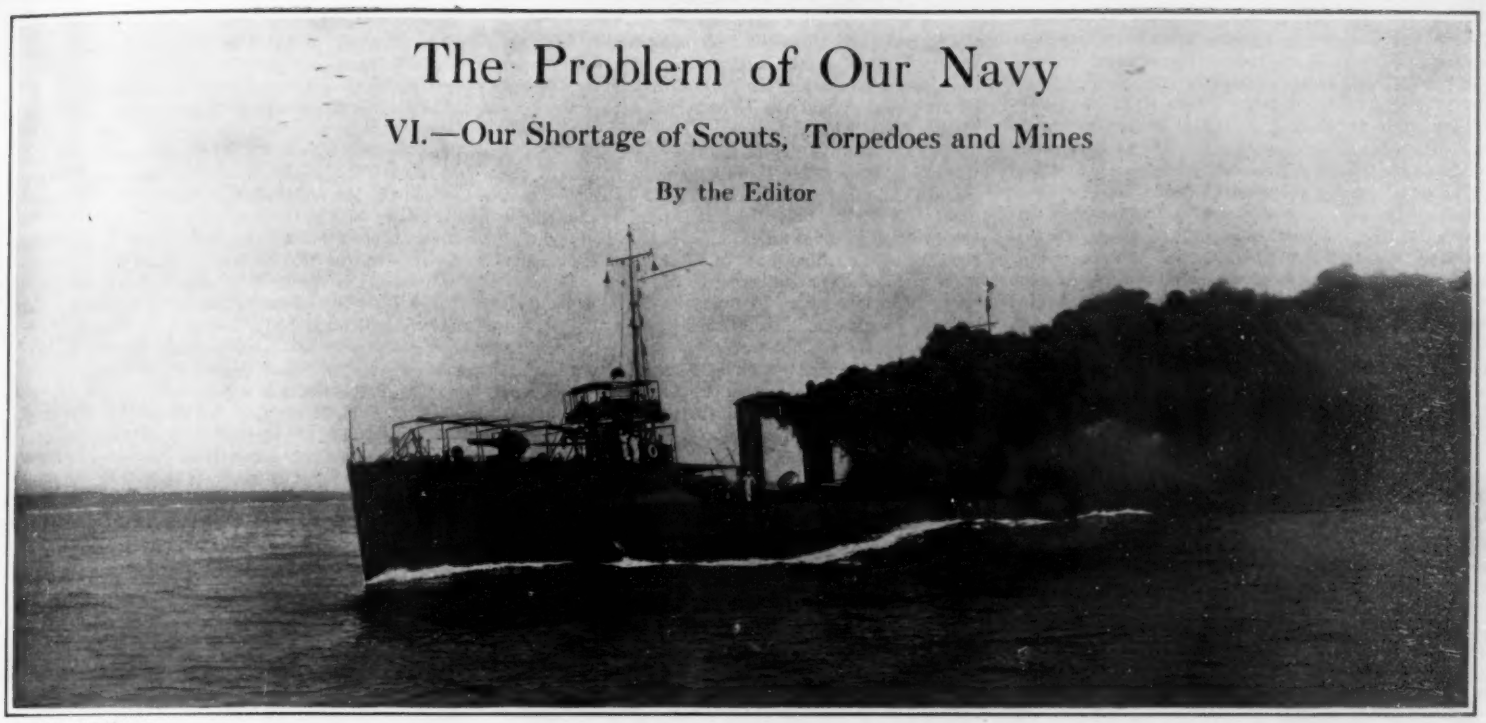


That the brightness of a star is no measure of its distance is shown by this diagram. Canopus stands second only to Sirius in brilliancy, yet it is nearly sixty times as far from us.

The Problem of Our Navy

VI.—Our Shortage of Scouts, Torpedoes and Mines

By the Editor



IT is the duty—the patriotic duty—of the Press to present facts of grave national importance exactly as they are. To conceal defects, because their disclosure will destroy cherished delusions and wound the public pride, is to play traitor to a solemn trust. We offer no apology—nor will the public demand any—for drawing attention to the pressing needs of the American Navy and pointing out what must be done to bring it up to a definite standard of strength and efficiency.

We have shown that the Navy is deficient in battleships of the first class. Unfortunately, it is deficient, also, in those accessories which must be present in a certain definite proportion, if the battleship fleet is to realize its full efficiency.

Although the battleship will be called upon to play the star part in the great drama of a naval war, it must be supported by a strong cast, each filling a subordinate but most essential part. In this should be included scouts and hydro-aeroplanes for observation and information, destroyers and submarines for attack by the torpedo, vessels specially equipped for dropping mines athwart the enemy's course, fuel ships to provide a constant supply of coal and oil, ammunition ships to replenish the magazines, torpedo and mine depot ships, supply ships, repair ships, and last but not least, hospital ships.

In all of these types, our battleship fleet is more or less deficient, and in most of them, fatally so. It is not our purpose now to enter into this question in great detail, but rather to confine ourselves to a consideration of three of the above types of accessories, in which we are so woefully deficient that the effectiveness of our first line of battle would be most seriously impaired, both in the strategy preceding an engagement and in the tactics which would be employed when the rival fleets were drawn up within range to fight it out with gun and torpedo.

WE HAVE THREE SCOUTS WHERE WE SHOULD HAVE THIRTY. The rôle of the scout is strategic. Its work will be that of getting in touch with the enemy as quickly as possible and transmitting to the commander-in-chief the earliest possible news of his movements and probable intentions. The scout should be of high speed (not less than twenty-five to thirty knots), should possess large coal capacity, and should be of sufficient size, say from thirty-five hundred to five thousand tons, to enable it to maintain high speed in heavy weather. The scouts would be thrown far in the van of the battle fleet and disposed fan-wise over a wide area of the ocean, probably in a first and second line. The larger their numbers the closer will be their spacing, and the greater the difficulty for the enemy's scouts to pass through the screen and pick up information regarding the parent fleet.

At the present time, Great Britain possesses thirty-one scouts of from twenty-five to twenty-nine knots, Germany fourteen, and the United States three only, of twenty-four knots speed. At the present rate of construction, Germany in the year 1920, will have over thirty scouts and the United States, the way things are going at present, will have but three. Under such conditions, it would be necessary to use our destroyers for scouting purposes; but this would be to subject them to an arduous and trying service for which they are not primarily intended, a service which might impair their efficiency for the duty for which they are designed, namely, that of acting as a close protective screen around the battleship fleet. If the programme calling for the construction of six battleships per year in 1914, 1915, and 1916 be adopted, giving us a fleet of forty-six battleships in 1920, the construction of scouts should be taken up at an annual rate which would give us at least thirty of these vessels by the same date.

WE HAVE BUT ONE TORPEDO FOR EACH TORPEDO TUBE IN THE WHOLE FLEET. Nowhere does our Navy appear so ill balanced as in the matter of our torpedo supply. As matters now stand, we have mounted in the battleships, cruisers, destroyers, and submarines about one thousand torpedo tubes; and as an ammunition supply for these tubes, we have available about one thousand torpedoes, or an average of one round per tube. We should have ten per tube. This year the Bureau of Ordnance asked for the modest appropriation necessary to give us two rounds per tube. The House Naval Committee has refused it.

The modern torpedo is so swift, accurate, and powerful that it promises to become a rival of the big gun as a weapon of attack; nevertheless, matters are in such a deplorable condition in our Navy that, in the event of a first-class fleet action, after firing the first round, our torpedo tubes would be entirely without ammunition!

To find a parallel for these amazing conditions we have to imagine an army taking the field with one cartridge in each soldier's rifle, or a fleet advancing to meet the enemy with only one projectile for each of its guns!

It will of course be understood that our supply of torpedoes is not evenly distributed throughout the fleet. Some ships have more, some even less than one round per tube; but when we come to our fleet of destroyers, our principal arm in the torpedo service, we find, to give exact figures, that among one hundred and seventy-three tubes there are carried only one hundred and ninety-four torpedoes. This means that if our exceedingly fine flotilla of destroyers were engaged with the enemy, as soon as they had fired one round from their tubes they would be useless, either for attack or defense. The situation is so ridiculous and preposterous as to be scarcely believable.

In the earlier years of the growth of our modern Navy, the development of our torpedo service went on very slowly, and we had but twelve torpedo boats in commission during the Spanish War. Even such torpedo boats as we had were not used in that war for the purpose for which they were designed; and it was mainly due to the prominence given in the daily press to the fast destroyers owned by the Spanish, that in 1898 and 1899 Congress appropriated for sixteen destroyers and twenty-eight torpedoes. In those days, the service was slow to appreciate the importance of the torpedo, and this apathy or distrust was shown in the fact that no torpedo tubes were fitted in the battleships appropriated for at that time. Later, we awoke to the fact that the torpedo was not only practicable, but that it was destined to play a leading part in future naval warfare, and it was finally decided to equip all first-class battleships with this weapon, and to make serious efforts to remedy the deficiency of torpedoes in the fleet.

About this time, the Bliss torpedo (an American product) was improved by the increase of the diameter from 18 inches to 21 inches, and by the application of heat to the air before introducing it to the engine. The new turbine had a range of four thousand yards, and coincidently with the determination to install tubes on the new battleships, three hundred 21-inch torpedoes were contracted for, and one hundred 18-inch torpedoes were ordered for the new armored cruisers and submarine boats. From that time on, the development of the torpedo in efficiency was rapid and better methods of heating, including the introduction of water into the superheater—a most important improvement which added about fifty per cent to the range of the torpedo—brought this weapon to its present truly marvelous speed, range, and accuracy. To-day, the latest torpedo will run at a speed of twenty-eight knots for a distance of ten thousand yards, which is about the range at which modern battleship fleets will probably be engaged.

No country has given such attention to its torpedo service as Germany. So greatly are the Germans impressed with the important rôle that the torpedo will play in future warfare, that they have directed more attention to this than to any other method of attack. More money, relatively, is spent upon torpedo target practice and the various maneuvers incidental to the torpedo service, than upon any other branch of the German service. The maneuvers carried out by the destroyer and submarine fleets are complicated, difficult, very dangerous, and are practically unremitting. A German naval officer recently told the writer that it was believed in the German Navy that the great numerical superiority in battleships of the British, would, in the event of war, be largely off-set by the wonderful efficiency of the German torpedo service. "They would win, of course," said he, "but it would be at a cost in capital ships so great as to relegate the British navy for the time being to the second rank."

Now, although our backwardness in the matter of torpedo supply may have been due in earlier years to lack of appreciation of its importance, for many years past, that is to say, from the time when the torpedo demonstrated its enormous value as a means of attack, our naval officers have urged upon the country the necessity for obtaining at once an ample supply of this weapon, by purchase abroad, by encouraging its construction by private firms, and by an increase in the capacity of the Government torpedo factory.

The present dangerous and positively ridiculous conditions of one round only per tube is chargeable to Congress and to Congress alone. If the moneys asked for had been appropriated, we should not now find ourselves in the possession of a fleet of first-class destroyers that is practically without ammunition.

It takes about one year to build a torpedo, and the cost of each is about $5,000. We shall need to secure within the next ten years from all available sources at least ten thousand torpedoes, and these will cost in the neighborhood of fifty million dollars. The necessary number could be obtained, if the Bureau of Ordnance were authorized to provide for securing the needed supply before the end of the fiscal year 1924, an annual appropriation of $5,000,000 being made for that purpose.

We spend $180,000,000 a year in pensions; yet we begrudge spending one thirty-sixth of that sum for rendering serviceable our fine destroyer and submarine fleets, upon which we have expended some $50,000,000!

There are three possible sources of supply: first, the foreign manufacturer; second, the domestic manufacturer; and third, the Government factory. Since the supply to be obtained by purchase from abroad is uncertain, and liable to be cut off altogether, it should be the policy of the Government, by liberal patronage,

to encourage the private manufacturers to enlarge their plants, and it should also make the necessary enlargements of its own torpedo factory at Newport.

OUR SHORTAGE OF MINES AND MINING EQUIPMENT. One of the most important lessons taught by the Russia-Japanese war was that of the deadly efficiency of the mine, whether floating or anchored. Those of us who followed the events of that war have not forgotten the terrific blow struck at the Japanese battleship fleet by the floating mines which sent the battleships "Hatsuse" and "Yashima" to the bottom; or the tragic loss by the same means of attack when the "Petropavlovsk" went down in two minutes, carrying with her Russia's ablest officer, Admiral Makaroff. Time and again the ships of the contending fleets bumped into the floating mines which had been strewn in their way by the enemy, and, if they were not sunk, they were so seriously crippled as to be put entirely out of action.

The lessons of that war have been laid well to heart by the great naval powers; and the mining service has been developed to such a degree of efficiency that it will form one of the decisive factors in the tactics of future naval operations. A most important use of this weapon will be made by the fast scout and destroyer flotillas in fleet engagements. The maneuver will consist in steaming swiftly across the head of the enemy's battleship column and dropping a number of mines across his course. This will necessitate his changing course, either toward or from the fleet with which he is engaged; and, in either case, he will be placed at a great disadvantage as regards his own and the enemy's gun fire—as regards his own, because he will be more or less in the head-on position, and his fire will be curtailed; as regards the enemy's attack, because he will be exposed to a raking fire in which the hits will be more frequent and more destructive.

By way of illustrating the value of floating mines and fully equipped mining ships, specially designed for dropping them in great numbers and swiftly over a chosen stretch of water, we close this chapter with a description of the loss of the Japanese battleship "Hatsuse" during the blockade of Port Arthur. The facts were given to the writer by an eye witness, Captain, now Admiral, Von Essen of the Russian navy.

The Russians had determined by instrumental observations that the Japanese blockading fleet steamed during the daytime back and forth in front of the harbor on a pre-determined course, laid apparently between two landmarks. Accordingly, one night they sent out their mine-laying ship and dropped a string of mines, or rather two or three of them, across the Japanese course as thus determined. The next morning, a group of naval and military officers gathered, at dawn, on one of the lofty hills surrounding Port Arthur, and saw the Japanese fleet come up out of the offing and proceed to steam on its regular route. The "Hatsuse" was at the head of the column; and when she entered the mine field, a huge column of water was seen to rise at her bow, and in a few minutes time this, one of the finest ships in the Japanese fleet, had disappeared!

This terrific engine of warfare destroyed or seriously crippled during the Japanese war more battleships and cruisers than the torpedo. Yet it is a fact that our supply of mines is even smaller than our torpedo supply, which, as we have seen, amounts to only one round per torpedo tube. This most serious state of affairs is not chargeable to the Navy Department, it is due to the failure of Congress in past years to listen to the warning of its naval advisers, and its refusal to make the necessary appropriations.

Gravitation and the End of the World

By John W. N. Sullivan

THE law of gravitation, as formulated by Newton, is one of the greatest generalizations in the history of science. The magnificent structure of modern dynamical astronomy rests upon this law as its basis, and the variety and grandeur of the phenomena it has proved itself able to explain, have raised it to a level of importance, and invested it with a degree of certitude, which scarcely any other generalization in science possesses to the same degree. But, in spite of this, doubts have from time to time arisen whether the law, in the form in which Newton left it, is quite exact. According to Newton, the attraction between two bodies depends upon the masses of the bodies, and varies inversely as the square of the distance between them. It has been suggested that the inverse square law is not quite accurate, and also that the relative velocities of the bodies concerned may affect the force of attraction between them. These hypotheses have been suggested by the fact that certain minor phenomena in astronomy are not satisfactorily accounted for by Newton's law. There are certain slight motions of Mercury, Mars, Venus, the Moon, and Encke's comet which exhibit discrepancies with the theoretical motions calculated on the basis of the strictly Newtonian form of the law of gravitation.

It would appear that a revision of the law has become necessary. It is highly probable that the relative velocities of bodies do affect the force of attraction between them. In fact, on the modern electronic view of the constitution of matter, the mass of a body is affected by its velocity; and the force required to change its motion depends upon the relative directions of the force acting, and the velocity of the body. So that even if the gravitational force is directly proportional to the masses, the masses themselves depend to some extent upon their relative velocities. It is possible that this is the direction in which an explanation is to be sought, of the anomalies mentioned above. But the chief difficulty about the law of gravitation is the mere fact of its existence. The aim of modern physics is to explain all material phenomena in terms of electrons and ether, but the attempt to account for gravitation in this way is attended by the greatest difficulties. We have learned to regard electricity, light and heat as forms of radiant energy, all of which are transmitted at the same velocity, but it seems almost impossible to account for gravitation along these lines. One thing which must be borne in mind is that gravitational forces are extremely minute in comparison with electrical forces, so that on an electric theory of the universe, gravitational forces may be treated as in the nature of residual effects. As illustrating the relative minuteness of gravitational forces, we may mention that if the opposite electricities were extracted from a milligramme of water, and given to two spheres one mile apart, those two spheres would attract each other with a force equal to the weight of twelve tons. In the older etheric theories, the ether was treated as an elastic solid, and in the equations to wave motion in an elastic solid we have a term which admits of compressional waves, as distinguished from the transverse waves which we know to constitute light. This compressional wave could have any velocity we please. Laplace showed that if gravitation has a finite velocity of propagation, its speed must be much greater than that of light, and he assigned as a minimum speed for gravitation a velocity one hundred million times that of light. More recent work has reduced this estimate, but it is still considered that the speed of propagation must be in the neighborhood of a million times that of light. From this point of view, compressional waves in the ether would offer no difficulty, but, as the result of a mathematical investigation by Larmor, it appears that such a theory would lead to a repulsion between bodies instead of an attraction, and a repulsion, moreover, which does not obey the inverse square law.

Lorentz endeavored to explain gravitation by assuming that in matter, considered as built up by negative and positive electrons, the attraction between a pair of electrons of unlike sign exceeds the repulsion between a pair of electrons of like sign. But on this hypothesis, the gravitational action between two bodies should vary with the nature of the intervening medium to an extent which should be easily observable, whereas a striking feature about the gravitational attraction between two bodies is that it seems to be quite independent of the nature of the medium between them. Laplace has shown that the attraction of a molecule at the center of the earth, upon a molecule at the surface, could not, in accordance with the known agreement of Lunar theory with the results of observation, be diminished by as much as one part in a million, owing to absorption in its passage through the earth.

A remarkable consequence of assuming gravitation to be an action transmitted by the ether was pointed out by Maxwell. He showed that this assumption necessarily leads to the conclusion that every portion of the ether possesses an enormous intrinsic energy, and that the presence of material bodies so influences the medium as to diminish this energy whenever there is resultant gravitational attraction. Sir Oliver Lodge estimates that the value of the intrinsic energy of the ether, when in the undisturbed condition, is of the order of 10^{32} ergs per cubic centimeter, and it is very probable that this estimate is much too low. It is interesting to see whether a maximum limit can be assigned to the gravitational force in the universe. If the number of bodies in our ethereal universe is indefinitely great, it has been pointed out by Neumann, and later by Seeliger, that the force of gravitation may become indeterminate at certain points, and even infinite. It has been attempted, but without success, to find some modification of Newton's law which would obviate this difficulty without coming into conflict with the results of astronomical observation. The difficulty may be overcome if we adopt the very remarkable hypothesis of Föppl, by postulating the existence of negative, as well as positive, masses in the universe. If the sum of such negative masses were assumed numerically equal to the sum of the positive masses, all the lines of gravitation force, like those of electric force, would start from positive masses and end on negative masses. Moreover, negative masses would attract one another according to the same law as positive masses, and in our present state of knowledge it would be impossible to distinguish a system of negative masses from one of positive masses. Of course, a system of negative masses would repel a system of positive masses in the neighborhood, but at the present time all such actions, owing to the great distances apart, assumed in consequence of these mutual repulsions, would probably be too feeble for observation.

Schuster has also pointed out that the existence of such negative masses would afford an explanation of the origin of the rotational velocity of the solar and other stellar systems.

The electromagnetic scheme does not seem sufficient to explain gravitation, but before considering some of the modern theories which have been proposed, we must deal briefly with the celebrated hypothesis of Le Sage, which was propounded in 1750, and recently resuscitated for a time by Kelvin. Le Sage assumed that all space is being constantly traversed by shoals of minute particles which subject all bodies to a state of continual bombardment. An isolated body is bombarded equally on all sides, and so is subject to no resultant force. But if two bodies are near together they exert a mutual screening action, and the result is a force tending to urge them together. Such is the essential theory, and it can be worked out so as to agree with Newton's law of gravitation. But to do this necessitates the assumption that an enormous amount of energy is being continually contributed to the universe by these corpuscles, and Maxwell showed that the heat so developed would be sufficient to volatilize the entire universe in a few moments. He remarks dryly that as a matter of experimental observation the universe is not volatilized and hence the theory cannot be true.

At the present time, in order to cope with the difficulties raised by the existence of the law of gravitation, scientific men have been compelled to assume that our ethereal universe only forms a portion of a greater universe, and to contemplate definite, physical actions extending beyond the extremest limits of that ether which fills all that we know as space. This assumption seems to be necessary, and indeed, one theory conceives our space as being merely the three-dimensional boundary between two four-dimensional universes. Such strange hypotheses would have been ridiculed a few years ago, but modern investigations in science have taught us that we are only touching the fringe of the unexplored possibilities of nature, and that we live in a universe wonderful beyond all our dreams.

From 1863 to 1875, Bjerknes published some investigations dealing with the problem of pulsations of two spheres in a fluid, pulsations being defined as consisting of periodic changes of volumes, just as vibrations consist of periodic changes of position. It appears that such pulsating spheres act on one another with a force whose principal part varies inversely as the square of the distance, and this applies to slightly compressible, as well as to incompressible, fluids. It occurred to Prof. Hicks that this method might be applied to account for gravitation, the electrons being the pulsating bodies, and the ether the fluid medium in which they are immersed. In order that the members of such a system may mutually attract one another, it is necessary that the phases of pulsation for the various electrons should not differ by more than 90 degrees. If we do not restrict the phases in this way, then the electrons will not necessarily attract one another. It would be possible for the bodies of one star system to attract those of a second, repel those of a third, and to exert no action whatever on members of a fourth system. This theory therefore provides for the existence of both positive and negative masses, and also for the existence of neutral bodies. It would be quite possible for bodies neutral to our system to be driven into its vicinity by repulsion from other systems, and thus the theory suggests the possible existence of weightless matter within the limits of our system. Sir Joseph Larmor suggests that "we may imagine the pulsation to have been applied initially over the outside boundary of the ethereal universe, and thence instantaneously communicated throughout the incompressible medium to the only places that can respond to it, the vacuous nuclei of the electrons; and we can even imagine the pulsations thus established as spontaneously keeping time and phase ever after, when the exciting cause which established this harmony has been discontinued."

It has been shown mathematically that in order that the law of attraction should reign throughout our universe, the waves impressed on the ether from that unknown and inaccessible region beyond our universe would have to have a wave length more than twice as long as the greatest distance for which Newton's law of gravitation is known by astronomical observation to hold good. The velocity of these compressional waves is taken as being 2.19 by 10^{27} C. G. S. That is to say, a light wave traveling at a speed of about 186,000 miles a second would take more than two thousand million years to travel the distance traversed by a compression wave in a second. The energy conveyed by these enormous waves is on the same gigantic scale as their velocity and wavelength. The energy passing in a second across an area of a square centimeter at right angles to the direction of transmission has the enormous value of 3.4 by 10^{21} ergs, an amount of energy exceeding by many million times the sun's entire store of available heat.

Another hypothesis which has been adopted to explain gravitation is to assume the existence of a steady hydrostatic pressure transmitted through the ether. Kelvin showed that when a steady or twistless flow is once estab-

lished through one or more apertures in a movable solid immersed in a liquid, it will continue unchanged forever, but that if there are two or more such solids within a finite region, mutual forces will arise in consequence of the flow. A steady flow of ether, either into or out of every electron in a gravitating system of bodies, would give rise to forces of attraction between them, varying inversely as the square of the distance. The theory explains Newton's law of gravitation, and also provides for the existence of negative masses. In order to avoid the conception of the continual destruction and creation of ether, we must, in accounting for this etheric flow, assume either a slow, steady expansion or contraction of the electrons, or a flow of ether through every electron between our universe and a greater universe of which it forms a part. Since every electron must lie on the boundary of this greater universe, in the latter alternative, this greater universe must be a four-dimensional universe. This conception may be repugnant to some minds, but the first alternative also leads us to sufficiently startling conclusions. Schott has worked out mathematically the hypothesis of expanding electrons, in reality assuming a slow pulsation of extremely long period, as we can hardly suppose an electron to expand indefinitely. Dr. Schott suggests a rate of expansion which would double the size of an electron in three hundred million years. It would be necessary to ascribe to the ether a density of 10^{100} times that of water. On this theory there will come a time when the expansion of the electrons gives place to contraction, but there would be a sensible period when neither expansion nor contraction was experienced. This would mean the cessation of all gravitational attraction, and of all cohesion in bodies, in other words, a catastrophic upheaval of the entire material universe.

A Vindication of Adjustable Wings

By Carl Dienstbach

THE "Paul Schmidt" biplane, which the writer hailed as a decisive step ahead in the development of aviation, when it made its appearance in the recent aeronautical "salon" at Paris, has since furnished convincing proof of the correctness of his assertions. It has established height records of 7,000 feet with five and of 5,300 feet with six passengers. Thus it has conclusively set at rest the principal and natural objection of the constructor of the old type of aeroplane with wings and fuselage, the objection that an adjustable angle between wings and fuselage is not "practical" because the structure would be weakened. Flying and landing with such a load put the structural solidity of the machine to the most severe test possible, and, incidentally, showed how little the added mechanism increased its weight.

It has equally proved the truth of the aerodynamical and aerodromical advantages claimed for wings of variable angle, because the phenomenal carrying capacity directly resulted from this arrangement.

The pilot, Garraix, started (on January 31st, at Chartres) with the angle between propeller thrust and wing chord adjusted to four degrees; when at 3,000 feet he could not climb higher with his load, he increased this angle to six, and, to attain 6,000 feet, to eight degrees. At the maximum altitude of 5,300, it was nine degrees. (The maximum angle of adjustment is 12 degrees, but this produces not the greatest absolute lift of the machine, but only the greatest lift at slow speed, for starting and landing and the "airhole." With the immense surplus lift of this machine as proved by these weight-carrying tests, it can, with normal load, be rightly acclaimed as exceptionally safe. Incidentally, the way this remarkable performance (with five up to 5,300 feet it took only 37 minutes) was accomplished, corroborates the writer's assertions as to how and why it was possible to establish a height record with a "baby" Wright racer. The only improvement still needed to realize the full safety advantages of the "Paul Schmidt" is in providing a mechanism which by power may change the inclination of the wings in case of danger as quickly and gradedly as a rudder is changed by hand—no very difficult task for an inventor. It is to be hoped that the prejudice in favor of directly-driven, relatively small propellers and of non-adjustable propellers may likewise soon be relegated, like the ancient prejudice in favor of muzzle-loading rifles, to those begotten by inventive laziness.

Wireless in the Antarctic

THE Austrian expedition under Dr. König, which is to sail for the Antarctic this year, proposes to establish a wireless telegraph station at its base in the Weddell Sea region. On its way south the expedition will erect an auxiliary wireless station in South Georgia. Thus the explorers hope to keep more or less constantly in touch with the world, as Dr. Douglas Mawson has done, on the opposite side of the Antarctic continent, by means of his two wireless stations—one in Adélie Land, and one at Macquarie Island.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Bad Orthography on Films

To the Editor of the SCIENTIFIC AMERICAN:

I cannot understand why Portuguese, or any other foreign language, could not be written on moving picture films with the same care and correctness as on some catalogues sent out by important firms of the United States. I've noticed that almost all film makers take very little care in producing a well written film. It would be ten times better not to attempt translation than to fill a drama or a tragedy with such letters as will provoke laughter owing to its absolute lack of orthography.

Another great defect is the duration of written matter on the screen. Some are too short while others tire the audience. These faults are very easily remedied.

Joinville, Brazil. R. W. T.

[Our correspondent is unquestionably correct in his contention. Here in New York the same bad spelling is noticeable. Some of the printed matter exhibited on films which have been imported from France are crude translations, obviously incorrect in some cases and unidiomatic in others. As for the amount of reading matter which is offered to the public by way of explanation, it must be stated that the tendency nowadays is to reduce it to its lowest terms. Even the explanatory letter which at one time seemed almost inevitable is now encountered only occasionally. Gradually it is recognized that the film must employ its own technique, in other words that photography is not literature.—EDITOR.]

A Letter from an Old Reader

To the Editor of the SCIENTIFIC AMERICAN:

It may interest you to know that I was introduced to the SCIENTIFIC AMERICAN in 1858. It was the "Golden Key" that opened Nature's wonders to my youthful eyes, as explained to me through my father's evening readings from your journal, and who was your subscriber, along about that time, and up to 1860-61, and again after his return from "The Front."

As I remember this publication of those long ago days it was about 8 inches by 12 inches and four pages. I am not positive, but it was somewhat small. I recall an incident in my life in which the SCIENTIFIC AMERICAN was a factor. In the autumn of 1858 Donati's comet was a most brilliant object in the western sky, the nucleus pointing toward the horizon, its immense tail flaming away toward the zenith. The SCIENTIFIC AMERICAN was loaded with all kinds of speculations about the big visitor bumping the earth, and of course it got my youthful mind so full of fearful ideas that I was ready to explode on the least provocation. Well, one afternoon a tremendous wind and rain came tearing out of the northwest, but as our dwelling was located on the side of a big hill I could not see the approaching storm, but the roar was enough. I shouted to my mother, "Look out, here comes the comet!" I got down on my knees and put in the hottest five minutes of prayer that ever a boy did. The supplication was opened in our door-yard, but the amen occurred in an adjoining cornfield. Like the darky preacher treed by a bear: "Oh, Lord, if you is going to help anybody, don't you help the bear." I was positive that the infernal thing had punched a hole in the adjoining scenery somewhere.

I always laid that "blow out" to the SCIENTIFIC AMERICAN. CHARLES W. HANSEN.

Erie, Pa.

Snow Removal

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of March 14th, I notice what Mr. P. A. Hutchinson of New York has to say regarding snow removal. I fully agree with him when he says: "A power shovel, mounted on a motor truck, would seem not difficult to invent."

And further, I wish to say that one on similar lines was recently invented, and a notice of that fact mailed to Commissioners of the Departments of Street Cleaning in several large cities in this country and Canada. Each was asked if there was a demand for a machine of this kind. All answered in the affirmative, except Mr. Fetherston of New York city.

His answer follows, under date, February 23rd, 1914:

"Referring to your letter of the 20th instant, the Commissioner directs me to say that there is no demand for a loading machine. The greatest difficulty is to secure a proper number of carts to carry off the snow."

A. B. MCSTAG, *Secretary to the Commissioner.*

Doubtless if this had been called to Mr. Fetherston's attention at a time when he was not "snowed under" with work it would have appealed to him as quickly as it did to the others. If it takes one minute to load a wagon with a power shovel, and ten minutes to load one with hand shovels, it is quite obvious that the former could be kept on the move almost continually, while the second could not, thereby greatly increasing the number of loads in a given time.

I also think if dump cars were used on the street car tracks for hauling, as Mr. Hutchinson has suggested, combined with a practical power shovel, the problem of snow removal would be solved to the satisfaction of taxpayers and the public in general.

Shelburne Falls, Mass. F. H. BASSETT.

Bacterial versus Inorganic Fertilizers

To the Editor of the SCIENTIFIC AMERICAN:

I have read with great interest the recent discussion in your paper of "Bacterial versus Inorganic Fertilizers." Mr. W. H. Bowker's letter shows that he is evidently not acquainted with modern agricultural thought and practice. The growth of the fertilizer industry is no more of an index to its true worth than would be the development of the art of patent medicine. Such things may flourish through the ignorance of customers and the desire to make mor ey.

Mr. Davis, in his letter of January 24th, states the facts so clearly that there can be no room for argument.

The modern farmer is a business man, cultivating food for man in a more or less finished form, and one of his great problems is that of keeping up the fertility of his soil. In doing this his greatest undertaking consists in keeping up its humus content, this being necessary to make plant food available for holding soil in good tilth and preserving its moisture-retaining powers. His nitrogen supply comes from his forage crops, alfalfa, clover, peas, vetches, etc. It is a by-product, and a steady and sure way of obtaining it is one of no cost and not at all a haphazardous matter.

Mr. Bowker thinks that beginners would be satisfied if they could be grown as easily as weeds. Well, they can. Sweet clover is one of the best, and is coming into greater use every year, although it was for a long time regarded as a mere weed. There are hundreds of acres of alfalfa that have stood for over twenty years in a country subject to much freezing and thawing, with a recorded temperature range of from —56 deg. to 110 deg. Fahr. Mineral nitrogen may have some use in the building up of our worn out Eastern soils. Their condition is not a result of scientific agriculture, but because of the burning up of their humus, by mismanagement and the misuse of commercial fertilizers.

By all means use all the by-product nitrogen possible. This is conservation; but it is not conservation to make something by an expensive mechanical process that can be obtained as a by-product at an outlay neither in cash nor in labor. INGOLL BIRKELAND.

Judith Gap, Montana.

To the Editor of the SCIENTIFIC AMERICAN:

As bearing on the subject of "Bacterial versus Inorganic Fertilizers," discussed by R. W. Davis of Moline, Ill., in your issue of the 24th of January, and by W. H. Bowker of Boston, in your issue of February 14th, I am taking the liberty of quoting a paragraph from Bulletin 145, issued by the South Carolina Agricultural Experiment Station of Clemson Agricultural College, designated "Fertilizer Experiments With Cotton," which is as follows:

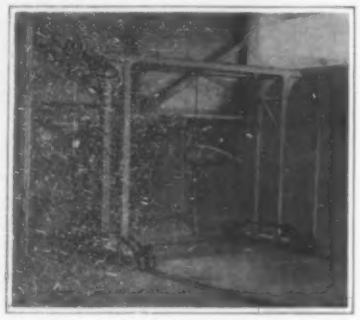
"... We also note that where lime was applied to plots on which cow peas and vetch were grown there appears to have been a much greater accumulation of nitrogen in the soil, for these plots so treated have not responded to the use of nitrates, that is, they have given just as large yields where no nitrate was applied. These experiments indicate that lime not only assists the legumes in accumulating nitrates in large amounts in the soil, but assists in some way in keeping this nitrogen from being washed out of the soil during the winter—how we are not yet prepared to say. ..."

Since legumes that are not inoculated "fix" no atmospheric nitrogen, this is good evidence that it is possible to store in the soil through inoculated leguminous crops, where the land is limed, all the nitrogen required by the succeeding crop for its normal and continuous growth.

I would like to add that Clemson College and its fine staff of county agents advocate the feeding of the crops to farm animals so that the manure may be returned to the soil, providing not only additional nitrogen, but all the phosphorus and potash removed by the crop from the soil, with slight loss, and also a host of other bacteria of the non-symbiotic varieties, some of which also "fix" atmospheric nitrogen, and others which make insoluble compounds into available plant food.

Columbia, S. C. EDMUND A. FELDER.

Juniper from the Indian reservations of New Mexico and Arizona may prove an excellent source of material for lead pencils. Manufacturers are searching the world for pencil woods.

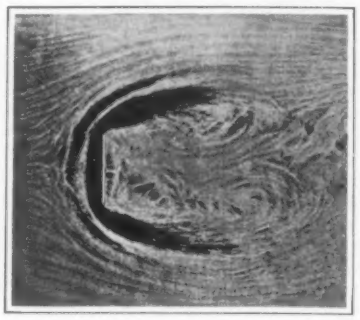


Laboratory room in the Crocco-Ricaldoni Institute.

How the Scientists Are Studying the Aeroplane

Institutes of Aerial Engineering and Their Work

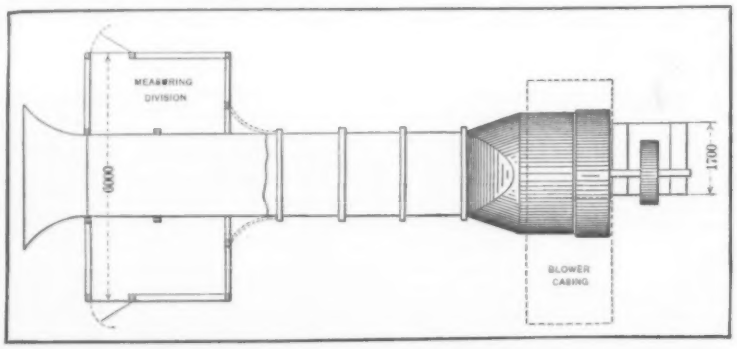
By Paul Béjeuhr



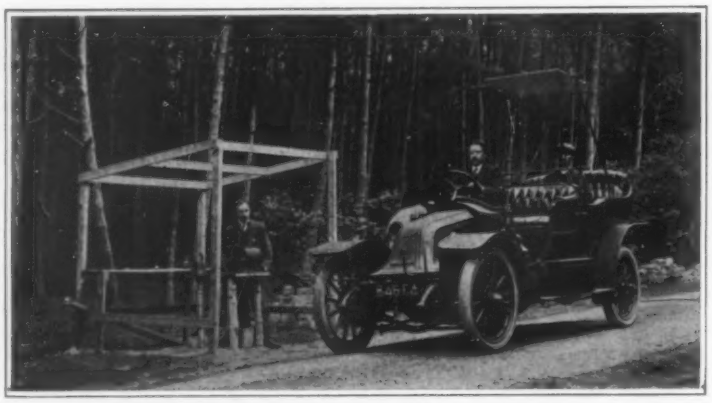
Air current lines as determined by Riabouchinsky.

THOUGH the first beginnings of successful aerial navigation are only a few years old, nearly all civilized countries already possess research institutes for the scientific investigation of problems connected with this art. This country still uses mainly the installations provided by S. Pierpont Langley at the Smithsonian Institution of Washington, though since the death of this eminent man, a certain stagnation in aeronautical research seems to have taken place. This is the more to be regretted as Langley's rotation experiments on the air resistance of all kinds of models had been developed to a remarkable degree of perfection. It will be remembered that in connection with these experiments a steam engine, through the intermediary of a bevel-gear drive arranged below the floor, served to actuate the rotating arm which also carried all the measuring instruments. The disk to be tested was fitted to a double lever pivoted round the end of the rotating arm. Under the action of the air resistance, one arm of the double lever would undergo a certain deflection recorded automatically by a style fitted to the other arm, which was kept in a central position by a system of four springs exerting a tension just equivalent to the air resistance. An electromagnet only allowed contact between the paper and style after the disk had reached a position of equilibrium, thus preventing any friction losses. The same apparatus, by a convenient combination with a falling-disk machine, a propeller testing outfit, a movable carriage, etc., was also used for other experiments. Furthermore, Langley was the first to show as far back as in May, 1896, the practicability of mechanical aeroplane models. Encouraged by these experiments, Langley, in 1903, prepared to launch a manned aeroplane designed on the same principles, but his extensive preliminary work was cut short by the aeroplane falling into the water and being entirely disabled.

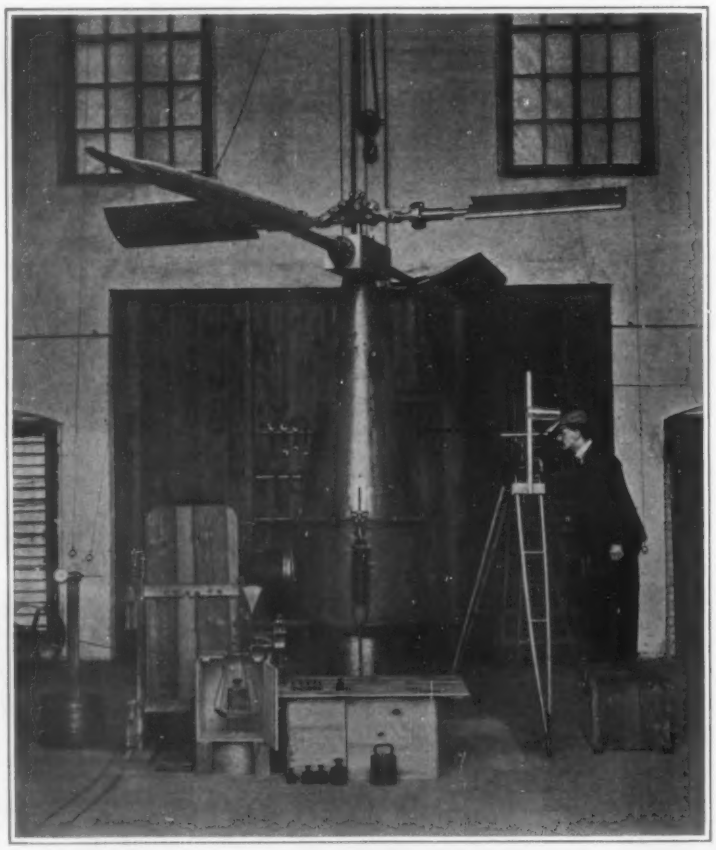
In England, there are, apart from Lanchester's investigations, conducted at the National Physical Laboratory, the installations of the National Physical Laboratory at Teddington, Middlesex, where some very important work has been done. The testing plant of this laboratory is based on Froude's model tests and comprises an air channel through which a circulating current of air is drawn by a sirocco fan. The measuring channel proper is arranged in the middle, the air being allowed to return at the outside, which of course complicates the arrangement. Vertical intermediate walls and sieves serve to ensure a uniform direction and distribution of the air throughout the cross-section of the channel. The object to be examined having been introduced through a slot, is suspended from one end of a double lever, the other end of which allows the buoyancy and resistance to be gaged. These tests, made at a wind velocity of 20 meters per second, showed the buoyancy due to air resistance to reach a maximum with an inclination of about 7 degrees. The resistance coefficients of vibrating wires were also tested and found to be practically the same as with fixed wires. A rotary outfit built up of light steel tubes is used for the examination of propeller models. Another very useful arrangement is the aeroplane motor-testing plant. The motor to be tested is braked electrically by means of a dynamo, while being submitted over a cross-section of 1,200 square meters to an air current of up to 35 kilometers per hour, thus imitating, as closely as possible, the conditions of actual work. A similar motor-testing plant has, by the way, been installed by the Luftschiffbau-Zeppelin-Gesellschaft at Friedrichshafen, Germany. Another noteworthy arrangement is a lattice tower about 65 feet in height, with a rotatable platform for gaging air pressures on disks in a natural wind. These experiments have for instance shown a considerable increase in the intensity of the wind at a given place during 5 minutes, whereas no such increase could be observed at 137 meters distance. Arrangements for hydrodynamical tests have been made to supplement the former; the models used in this connection are at rest while the water current moves at speeds as uniform as possible throughout the cross-section.



Aix-la-Chapelle. Cross-section of wind channel.



Dr. Armand de Gramont's high-speed aeroplane testing track.



Lindenburg Institute air propeller testing apparatus.

Another remarkable English installation is the large air propeller-testing plant at Messrs. Vickers Sons & Maxim, Ltd., works at Barrow-in-Furness. This comprises a rotating lever 50 meters in length, the measuring arm of which, 33 meters in radius, turns in ball bearings round a huge cast-iron pillar, whereas the other arm carries the counterweight. Above the pillar there is the observer's cabin, where, in addition to any necessary instruments, a 100 horse-power electromotor for use in driving the propeller has been installed. Thus, this rotating outfit is only actuated by the air propeller itself. Thrusts are recorded by a slight axial displacement of the propeller shaft with the aid of angular transmitting levers, and the work expended is determined by examining the electromotor. This testing plant shows the advantage of eliminating the effects of wind.

Especially numerous are the aerodynamical institutes in France, as might be expected in a country which takes so eminent a share in the development of aerial engineering. Those created by M. Eiffel—mainly for investigating the laws of air resistance—are especially well known. After performing extensive falling tests from the lowest story but one of the Eiffel Tower, he erected a special aerodynamical laboratory on the Champs-de-Mars which mainly contains an air channel where tests on immovable models with artificial air currents are made. A sirocco ventilator, 1.75 meters in diameter, draws in some air from the laboratory hall, conveying it round its sides into a larger hall where it is allowed to calm down, in order, eventually, through a system of channels, to return, at the proper speed, into the laboratory hall. Between the air outlet and the suction tube there is the experimental room proper. The disks or other models are suspended from a special balance which, by slight adjustment, allows the resultant of the buoyancy and resistance to be ascertained. This balance is installed on a bridge above the laboratory room proper. The well-known steam-turbine constructor, M. Rateau, has installed a similar plant for the testing of models in a moving air current, in connection with which the air is likewise allowed to pass freely through the laboratory room proper, whereas, in all other testing plants (Prandtl, Reissner, Riabouchinsky) there is always an air current moving through a closed channel, which

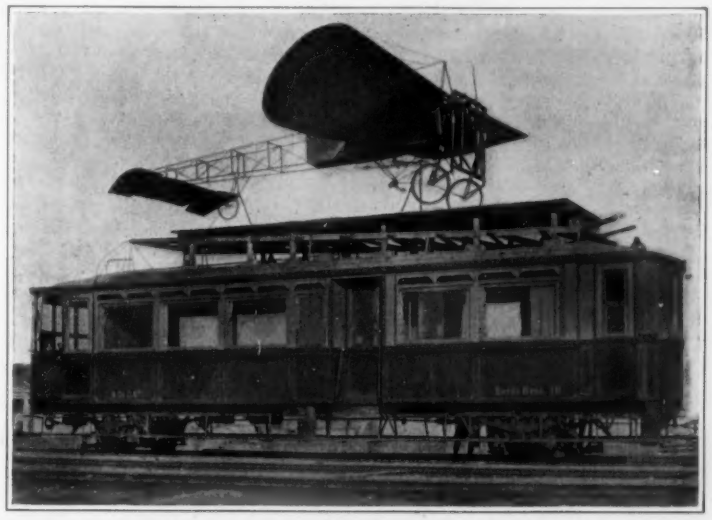
can therefore not be entered during tests. The most recent creation of France is the Institut Aérotechnique of the Paris University at St. Cyr, founded by Henri Deutsch de la Meurthe. This comprises, on a large plot beside the main building, a special rotary test-plant shed and a straight track 1,360 meters in length, which will be used for resistance tests on disks placed in a natural air current, as well as for the testing of propellers. The main building comprises a huge exhibition hall which will at the same time be used for all kinds of experiments, and to this are connected on both sides the laboratories and research rooms, while the testing machinery takes up one of the transversal sides. The testing truck, on the straight experimental track, is propelled at a speed of up to 25 meters per second, by electro-motors deriving their current from rails running alongside the track, and as these motors are steered from the roof of the Institute, the trucks can be run unmanned. The traveling speed is recorded by a chronograph and tachograph, and the resistance thrusts on the surfaces are tested by hydraulic measuring instruments actuating special recording manometers.

Reference should also be made to the tests made by Dr. Armand de Gramont, Duke of Guiche, which mainly relate to the distribution of pressures on disks in a natural air current. The disks used in this connection were fixed to an outfit installed above an automobile traveling at a high speed on a good forest road, where practically any side wind was kept out.

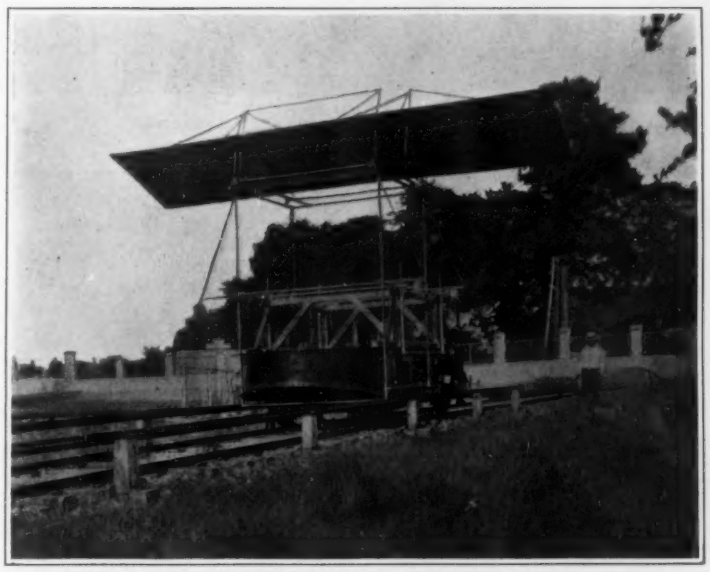
In Italy should be mentioned the arrangements provided by the *Brigata specialisti* on plans by Captains Crocco and Ricaldoni, which are continually being extended. The wind channel used in this connection shows the special feature that measurements are made just in front of its mouth, after which the air is allowed to escape into the open. The fan 2.5 meters in diameter has thus always to draw in a new supply of air; it is operated by a 30 horse-power electro-motor, and imparts to the air current a speed intermediary between 2 and 29 meters per second. The air current at first enters a large iron tank where it is allowed to calm down. Having thus been freed from any eddies, it penetrates through a tube one meter square into the laboratory-room proper. A traveling frame from which the models are suspended is moved in front of this mouth. An improved Renard dynamometrical balance is used to gage the work induced in the air propeller, independent of any losses in the driving motor and transmission devices. This balance comprises a light frame in the center of which the propeller to be tested is so suspended that the air current undergoes no deflection. Any motion in the direction of the air current is compensated by a proper weight put on a vertical arm of the frame. The propeller obstruction (due to its torque) manifests itself by an inclination of the whole frame and is likewise compensated by weights. The results obtained in connection with the testing of dirigibles by means of special models suspended in a Cardan frame have been of especial value. A large tank, which is to be replaced by a canal 188 meters in length, 3 meters in width and 2 meters in depth, is used for tests on moving models in resting water.

Extensive tests have also been made on propellers (at first on models and afterward on actual propellers) either in a stationary plant or on a gliding boat.

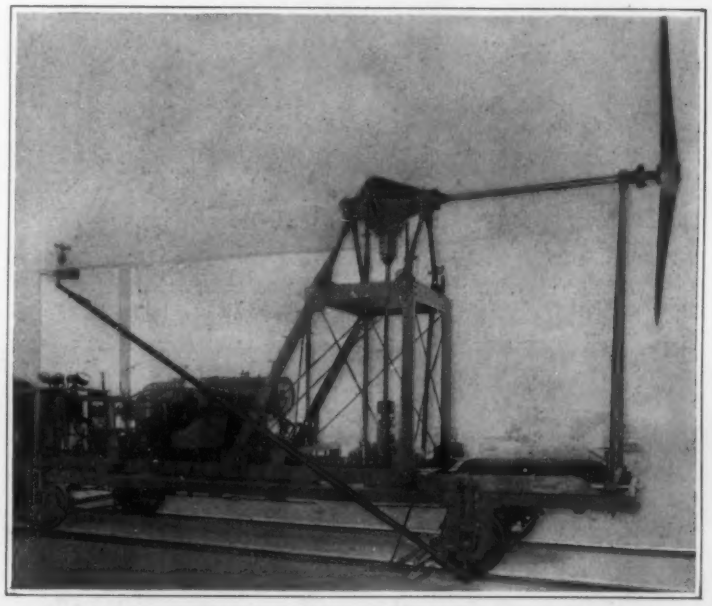
In Russia there are at present three aerodynamical institutes, both the University and Technical High School of Moscow being connected with testing plants, while a third institute at Koutchino is conducted by its founder, Riabouchinsky. The Institute of Moscow University has been in existence since 1902, and comprises two minor air channels, one of which is 1.6 meters in diameter and admits of an air speed of 20 meters per second. Into this channel is introduced a propeller testing apparatus, in connection with which the electro-motor, direct-coupled to the propeller, is arranged in a light frame free to rotate as a simple lever round a point in the channel wall, its weight being compensated by proper counterweights. The propeller thrust manifests itself in the same sense, and is likewise determined by weights. The Institute also comprises apparatus for falling tests and experiments on the escape of highly-compressed air. Of the aerodynamical arrangements of the Technical High School there should be mentioned a special measuring channel designed for investigating the air resistance of plates the length of which is very large as compared with the width. The arrangements installed by Riabouchinsky are of the most varied description and relate to all the different branches of aerial navigation. Measurements in a moving air current are made in a huge air channel through which the air is drawn, not from the room itself, but from a larger cylinder which likewise serves to calm the motion of the air. In connection with model tests up to diameters of 0.5 meter, a modified Renard double balance is used. In the case of large propellers (4 to 10 meters in diameter), a somewhat different arrangement is employed, the propeller working in an upward direction against the free air stratum, thus exerting a downward thrust which is transmitted by a step bearing to a recording style. A set of beveled wheels is used for measuring the induced work.



St. Cyr testing car for use in resistance and propeller tests.



Prof. Donat Banki's arrangement for the testing of monoplanes.



Prandtl transportable testing plant, the carriage being driven by the propeller itself.

Experiments here have been made mainly on the influence exerted by the number of vanes on the efficiency of a propeller; up to what limits the projection of the vanes on the surface of the propeller circle can be increased, and similar problems. Most interesting resistance tests on disks in flowing water were made in a little river in the neighborhood of the Institute. Especially striking comparative tests have been conducted on the Ahlborn current lines in air, by means of a square plate lined with black paper on which lycopodium powder was spread uniformly.

In Germany there are, in addition to the research laboratories of the large aerial navigation companies and aeroplane-building firms (Testing Department of the Corps of Engineers, Zeppelin Company, Parseval Company, Siemens-Schuckert Werke, Messrs. Lanz, etc.), the Testing Institute of Professors H. Junkers and H. Reissner at the Aix-la-Chapelle Technical High School, the Aerodynamical Laboratory at Lindenberg, and the Aerodynamical Testing Plant of the Motor Airship Study Company at Göttingen.

The Aerodynamical Laboratory of the Aix-la-Chapelle Technical High School comprises an air channel through which the air is drawn by means of a centrifugal fan. In opposition to the Göttingen plant, where the same air current is used in continual operation, a new supply of air is always drawn in, thus allowing higher velocities (so far, up to 30 meters per second) to be reached with the same motor output, while insuring a great homogeneity, though these advantages are of course offset by the dependence on actual wind conditions. This plant has so far been mainly used for propeller tests.

The Lindenberg Aerodynamical Laboratory likewise is mainly intended for use in testing air propellers, no models but actual propellers being used and, as far as possible, under the natural conditions they will be called upon to work. The testing machine is operated by a 34 horse-power electro-motor through a belt and beveled wheels, and produces 40 to 600 revolutions of the propeller per minute. A hollow shaft and an axle rotating inside allow the two propellers to be driven in opposite directions. The propeller thrust can be compensated by means of step bearings, levers and weights, and the induced work is gaged hydraulically. A large number of systematical determinations have been made by means of this outfit, which yields especially valuable information on the working of lifting propellers. Experiments with manned and unmanned kites made at Lindenberg exceed in point of accuracy any work of a similar kind.

The model testing plant erected at Göttingen, on plans by Prof. Prandtl, mainly comprises a closed endless channel of square cross-section (2 meters square), inside of which the air is set in continual motion by a ventilating fan. A special regulator allows any wind velocity to be maintained irrespective of fluctuations in the mains feeding the electro-motor. A system of tubes of decreasing diameters distributes the air current uniformly over the whole cross-section, and a sieve with fine meshes eliminates any eddies. Resistances are determined by means of balances and sliding weights, and the distribution of pressures is read by means of micromanometers. The velocity of air currents is gaged by means of improved Pitot tubes. Balloon models are produced electrolytically on wax models, thus allowing a remarkable accuracy and low weight to be obtained. A propeller testing plant has been added.

A laboratory equipment likewise installed on plans by Prof. Prandtl, from funds of the First International Aeronautical Exposition (1909), held in Frankfort-on-Main, will most likely be used to supplement the Göttingen in-

(Concluded on page 300.)

The Most Powerful Government Wireless Plant

The United States Naval Station at Radio, Virginia

By John L. Hogan, Jr.

LESS than a year ago the Navy Department's most powerful wireless telegraph plant, at Radio, Va., near Washington, was completed, tested and taken over from the contractors. The towers and buildings were constructed for the Department from Navy plans, but the radio apparatus was designed and installed under the patents of Prof. R. A. Fessenden. The Radio station is the first of a proposed chain, linking by wireless the United States possessions throughout the Atlantic and Pacific, and its completion marked the first step in the realization of plans laid out by the federal radio authorities as early as 1909. At present work is going forward on similar high-powered Government plants in the Canal Zone and on the Pacific, so that before long it is expected that the more important centers of United States territory will be able to intercommunicate by naval radio, entirely independent of privately owned wire lines or cables.

Even in the absence of the additional power radio stations proposed, the plant near Washington is proving of great value. Time signals are sent out at several fixed hours each day, and by adjusting their wireless instruments to receive these impulses, officers aboard ships at sea are able to compare their chronometers with those at the Naval Observatory even though one or two thousand miles away. Equally valuable to the masters of vessels along the Atlantic seaboard are the

Fig. 1.—The aerial switch.

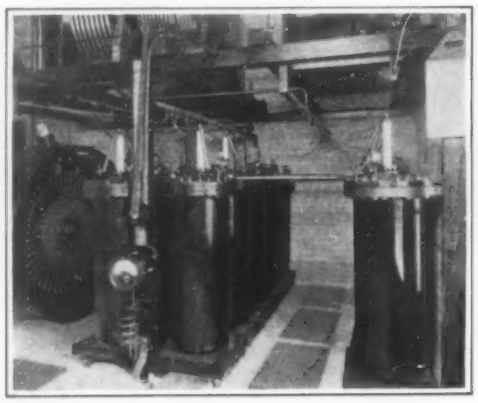


Fig. 2.—Compressed air condensers and rotary spark gap.

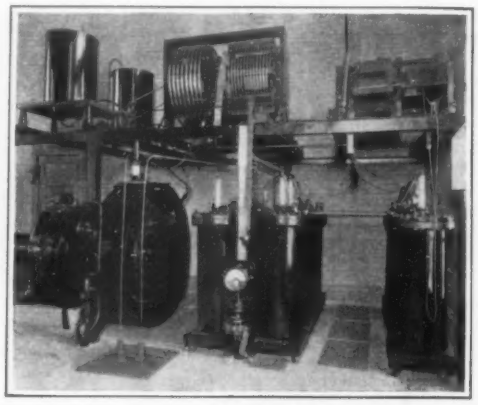


Fig. 3.—General view of the transmitter.

Fig. 4.—Tower leg and pedestal. Each leg rests on a similar concrete pedestal, and is equipped with a high potential switch.

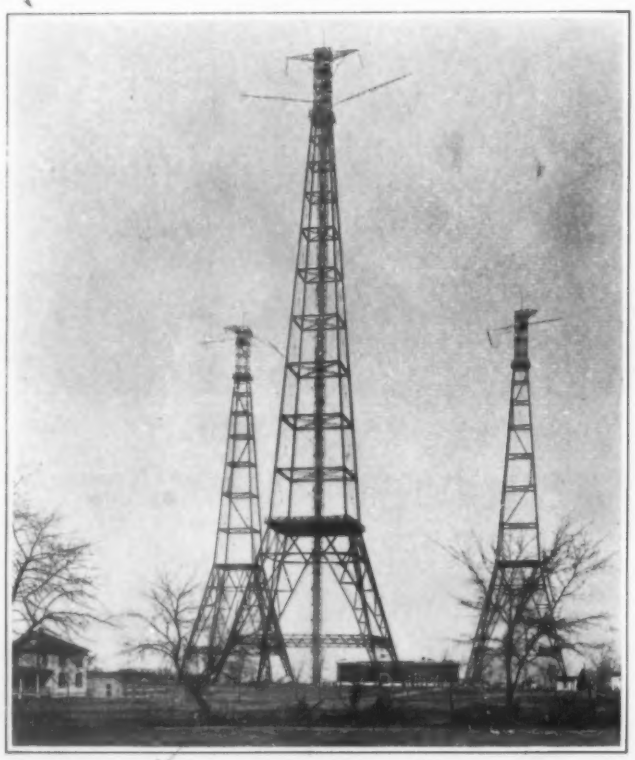


Fig. 5.—The towers and buildings at Radio, Va.

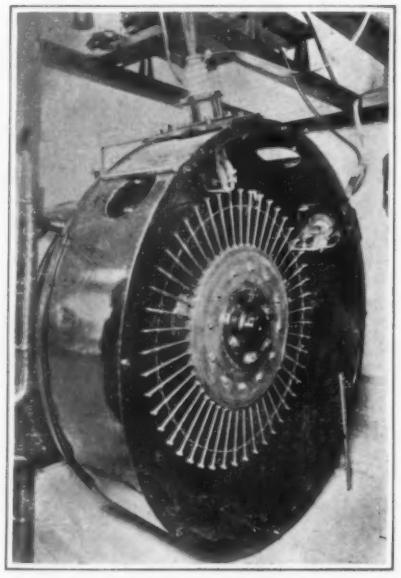


Fig. 6.—The rotary spark gap. Sparks can occur only when the revolving spokes are directly under the stationary electrodes.

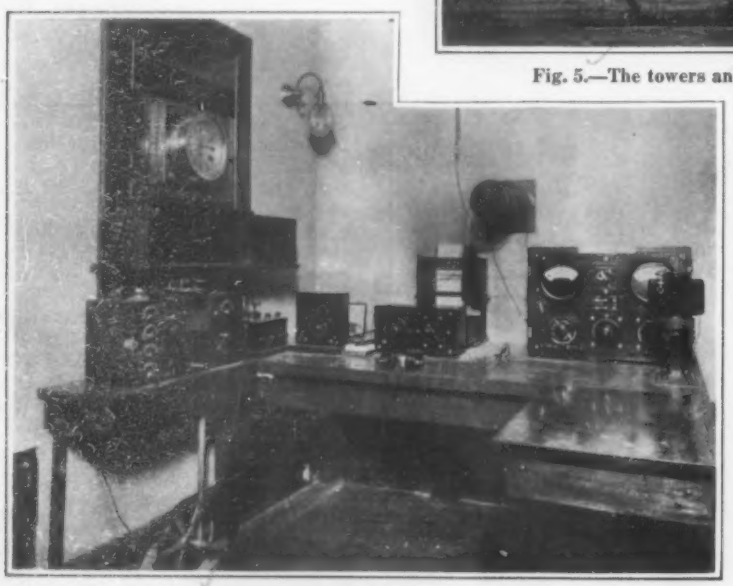


Fig. 8.—The receiving- and operating-room.

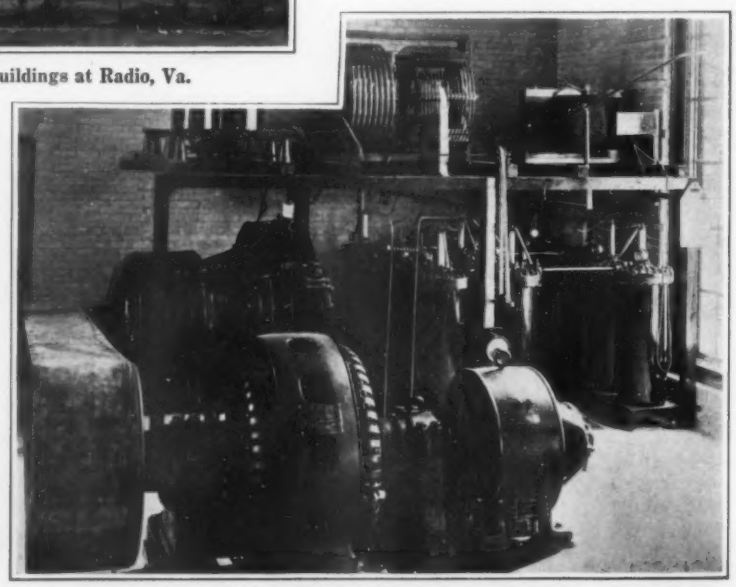


Fig. 7.—The transmitter, showing the 200 horse-power motor.

storm, ice, and derelict warnings transmitted at scheduled times along with various important weather and meteorological reports. Aside from these aids to navigation generally, the Navy Department is able to issue orders direct to any ship within two thousand miles or so, and likewise may transmit from the head offices of the wireless service, at Radio, direct to any of the naval installations along the Atlantic, and even to some of the Pacific coast stations. It has been the daily custom for the Radio station to exchange messages with the naval plants in range, beginning with Portland, Me., and taking in turn Boston, Newport, Brooklyn, Philadelphia, and the southern stations through North Carolina and Florida down to Colon, Panama. Tests between Radio and San Francisco are now being carried on, and it may soon be possible for these two stations to intercommunicate reliably at any time.

The apparatus and plant which makes possible this exceptional sort of radio transmission is interesting in all its details. As shown in Fig. 5, the station at Radio includes three enormous steel towers for supporting the antenna or aerial wires, and a large building divided into three parts. The central hall of this building contains the entire transmitting equipment, while the right hand wing (which is really an entirely separate structure) has in it the receiving room, a laboratory, and living quarters for the station personnel. The remaining wing is divided into additional laboratories, a machine shop and the executive offices of the Naval Radio Service. Near the extremes of the buildings, and 350 feet apart, are placed the two 450-foot towers. The 600-foot tower, shown in the foreground in the accompanying general view of the towers, is 400 feet from each of these, and stands at the acute apex of an isosceles triangle formed by the three. Fig. 4 shows a tower leg. Each of these legs rests on a similar reinforced concrete pedestal, and is equipped with a high potential switch for connecting the steel framework directly with wires buried underground. It has been found that the station transmits more efficiently when the towers are "grounded" in this way, and in addition the possibility of damage to the bases from lightning stroke is minimized.

From spreaders slung from the topmost point of each tower is threaded the enormous triangular fan of aerial wires which, when energized by the sending apparatus, sets up the powerful electromagnetic waves used in wireless transmission. These same wires are used in receiving messages, to collect from the ether the electrical power which brings signals from distant transmitters. On top of the wooden pole in the right-hand foreground of another illustration appears the aerial switch, which when operated by chains and levers from the receiving room connects the antenna wires to either the sending or the receiving instruments. A set of vertical wires drops from the big aerial fan to the top of the aerial switch, and by throwing the switch lever to the left or to the right the station is arranged either to send or to receive.

When the aerial switch is in its left-hand position the overhead air wires are joined to a large copper tube which is brought into the sending apparatus room through a glass window, as shown on the extreme right of Fig. 7. This photograph shows the entire transmitting equipment, and in it and Fig. 3 there may be traced the connection from the aerial through the tuning coils on top of the framework and down to the ground wires under the floor by way of a flat copper strip fastened to the central upright and leading through an electric current meter which shows just how powerfully the sender is operating at any time. In the foreground of Fig. 3 is shown the 200 horse-power motor which drives the radio transmitter dynamos and rotary spark gap. The electrical power as furnished by the central station near Washington is not suitable for producing the clear ringing musical sparks used in modern wireless telegraphy, and so it is necessary to convert it by means of the motor and dynamos shown. After this conversion, the power is led through the sending-switch and transformer, and then, at a potential of about 25,000 volts, to the rotary spark gap of Fig. 6. In jumping from one of the stationary electrodes at the top of this gap to the revolving spokes and then back to the other stationary electrode the electrical condensers (the vertical cylindrical tanks of Fig. 2) are discharged through the left-hand coil shown at the top of Fig. 3. Sparks can occur only when the revolving spokes are directly under the stationary electrodes, and during the intervals between each two spark discharges the condensers are recharged with electricity from the transformer. The condensers themselves consist of steel disks interlaced and supported on rods inside of the tanks shown. These tanks are filled with dry air pumped up to a pressure of 250 pounds to the square inch, which high pressure prevents electrical leakage and consequent losses in the condenser. The compact installation of this powerful transmitter was made possible only by the use of these compressed air condensers.

There are 48 spokes on the rotary part of the spark gap, so that when this revolves at its normal speed of 1,250 revolutions per minute sparks will occur at the rate of 1,000 in each second so long as the sending-switch above mentioned is held closed. This sending switch is operated by a magnet and controlled from a Morse telegraph key placed in the operating and receiving room. When the operator presses this key for short and long intervals corresponding to the dots and dashes of the Morse telegraph code, the sparks pass for identical short and long intervals. The spark-discharge currents acting inductively across the transformer tuning coils shown in Figs. 7 and 3 force the aerial wire system to emit into space similar short and long groups of electromagnetic waves, which travel along the earth's surface to the receiving station. The fact that the sparks occur only one one thousandth of a second apart causes them to produce a high, clear, musical note, corresponding in pitch about to the second C above middle C on the piano, and this characteristic tone is reproduced at the receiving station. The receiving operator, holding to his ears a pair of ordinary Bell telephone receivers, hears the short and long musical sounds made by the transmitter, and is able to retranslate them into words according to the telegraphic alphabet, distinguishing them by their tone from the scratchy and meaningless sounds of natural atmospheric electrical discharges.

Fig. 8 shows the receiving- and operating-room of the Radio station. The wire from the aerial switch runs down the back wall and may be connected to either of the two complete receiving instruments which are installed. Underneath the operating table is the lever controlling the aerial switch on the pole outside, and mounted on the table top is the telegraph key by which Morse signals are sent out from the transmitter in the main building. Since messages must often be received from small stations at such great distances that the incoming signals are very faint, the receiving-room has been built as nearly sound-proof as possible. A system of mechanical and electrical interlocks protects the operator from electrical shock in case he should attempt to send before disconnecting the receiving apparatus from the aerial wires, and signal lights permit him to communicate with the engineers running the sending dynamos. A Telautograph, or writing telegraph, connects with an adjoining room in which are installed telephone and telegraph instruments connecting to the commercial lines, and by its use faint messages being received by radio may simultaneously be relayed out over the land wires by a second operator without danger of the clicking of telegraph sounders disturbing their reception.

In the months that the Radio station has been in operation it has not only filled a great need by the transmission of time and meteorological signals, but it has also demonstrated its service efficiency by the establishment of many new records for consistent long distance radio signaling. Its performance has indicated definitely that as the projected series of high powered stations reaches completion the United States will own a chain of wireless plants which will lead the world in efficiency and utility.

Attractions of Variable-star Observing

By Edward Gray, M.D.

IN all North America there must be some scores of telescopes possessed by amateurs which are more or less idle or at least producing no contributions to science, mainly because their owners do not know how to use them profitably. After a period of recreation among double stars, the moon and the planets, does not many an amateur weary of finding nothing new and possibly even relegate the telescope to the attic?

At this juncture comes in the value of variable stars. It can only be want of knowledge of the pleasure along with usefulness of variable-star observing which has kept back amateurs from pursuing this branch of study and recreation. Is there indeed any other line open to amateurs, if we except the observation and discovery of comets, wherein the amateur may do original work of value and where his results may be made useful to the present and to future generations?

It is the aim of this article to point out how inviting a field to amateurs is the observing of variable stars, mainly those of long period. To begin with, it is a field but little cultivated and where hundreds of thousands of observations are required by astronomers for study. One's equipment need not be expensive or elaborate. A good field-glass will suffice for a small minority of observations; but in general a refractor of some aperture between two and seven inches or a reflector of four to nine inches is requisite. Two observers are known to me who use rather small apertures, namely, two and two and a half inches; and each does good work.

An equatorial mounting is time-saving and convenient to work with, but cannot be reckoned essential; perhaps a majority of the observers now in this line use a tripod mount. This implies much more work at first in learning the fields, but rapid work thereafter. After two years' practice, for example, a valued correspondent cited an evening when he had made twenty-six estimates and was back in the house at 8.50.

The periods or cycles of the stars to be observed vary greatly in length, from two months to well nigh two years. Hence the state in which variables are found at any given time varies much; some are waxing in brightness, some waning: a few are at, or near, maximum, others at minimum, and still others resting before either rising or falling. All this insures variety; there is nothing tedious about observing variable stars. Surprises are frequent and one's interest is kept alive; for while some stars are perfectly regular and move like clockwork, others are irregular enough in their fluctuations to furnish all the mystery necessary. Some are white, some yellow, some orange, some red; and a star red at or close to minimum may become orange or deep yellow near maximum. It does not at all follow that because the last period of *88* Cygni was nine weeks in length, the next one will be the same. On one occasion I found an interval of only forty days, an occurrence unique in my acquaintance with this star.

Beyond the telescope—and some place to use it—one's equipment requires only a good star-atlas and a number of charts of the variables to be studied. The intending observer should associate himself with the Society for Practical Astronomy (Chicago) and its Variable-Star Section or with the Association of Variable-Star Observers (Norwich, Conn.). The two bodies are co-ordinate, and most of those now engaged in this line belong to both. The necessary charts are procurable from the members and further from Harvard College Observatory, but conditional in this last case that a monthly report be made to its director. These charts once received, patience and perseverance do the rest. The way of the beginner is now easier than it was three or four years ago. There are magazine articles and manuscript "hints" which illuminate the path.

At present the literature is scattered in various magazines. The Society for Practical Astronomy publishes a *Monthly Register*, while the monthly reports of the Association of Variable-Star Observers appear in the magazine *Popular Astronomy* (Northfield, Minn.). These observations have grown to number 800 to 1,200 per month, according to the weather.

More observers are needed, however, to carry on the work properly. Volume 55 of the Harvard *Annals* says, for instance, of X Monocerotis: "Very few visual observations have been published, since the star does not appear to go below the tenth magnitude. It could easily be followed with small telescopes; and continuous observations, when the star is not too near the sun, are needed to learn the nature of the changes of this interesting variable."

Seldom does one pursue this line of research for six or more months without describing it as fascinating. But if the mere observing is fascinating, what shall we say of the intellectual profit and expanse of mind to be attained therefrom? For there are problems connected with these stars which may exercise even the best intellects. Why do some variables like R Hydrae and *s* Boötes shorten their periods, while others, like χ Cygni, lengthen theirs? Why does Mira Ceti sometimes barely exceed the fifth magnitude at maximum and at others attain the second? Why again does this star descend to the eighth magnitude only at some minima, but at others to the ninth, perhaps 9½? And why should it vary up to twenty days in either direction from its mean period of 331 1/3 days?

What physical cause is there why U Geminorum, *88* Cygni and *88* Aurigae should remain close to minimum for weeks or months and then suddenly rise, attaining maximum in a very few days? Why do very red stars usually have very long periods? And so on to more complex queries.

Astronomers require a vast number of observations to accumulate data required for elucidating the many problems relating to variable stars.

To sum up:

1. Observing variables is the chief line open to amateurs in which they may do good work and put their telescopes to useful account.

2. This pursuit has a charm which must be experienced to be appreciated. It does not grow monotonous.

3. It has an educative and intellectual value *sui generis*. This can be better understood after a practical acquaintance with the pursuit.

4. It is not very costly.

5. It leads to the formation of desirable acquaintances; for a cordial *esprit de corps* exists among its devotees.

6. It requires method in observing and in recording results, and leads to habits of exactness; likewise to the setting of problems to be worked out and to a desire for higher knowledge. Its influence is altogether wholesome upon mind and brain and temper. It is an uplifting pursuit.

7. It is constructive, not destructive; and adds to the sum of human knowledge.

A Wonderful Model of a Copper Mine

By J. W. Grigg

PROBABLY the most elaborate and realistic copper mine model in any museum in the world has just been placed on exhibition at the American Museum of Natural History. It required more than three years' work to complete it. The mine reproduced is that of the Copper Queen Consolidated Mining Company's property at Bisbee, Arizona. It was executed under the direction of Dr. Edmund Otis Hovey, curator of geology, by Mr. Arthur Briesemeister and assistants, and was reproduced from accurate and first-hand study of the mine itself.

It is another of the many interesting exhibits planned and completed in recent years at the museum in an effort to bring the institution into closer touch with the people, and to make the institution as interesting as possible to the person without scientific training.

It was early in 1910 that Dr. James Douglas of the company informed the museum authorities that he was prepared to furnish the data and the means necessary for the construction of a large scale model of the mine. That summer Dr. Hovey took his assistants to Arizona, where the first thing done was to determine upon the point of view from which the picture of the model as a whole with its proposed painted background should be obtained. Practically the same view is now spread before the observer in the museum.

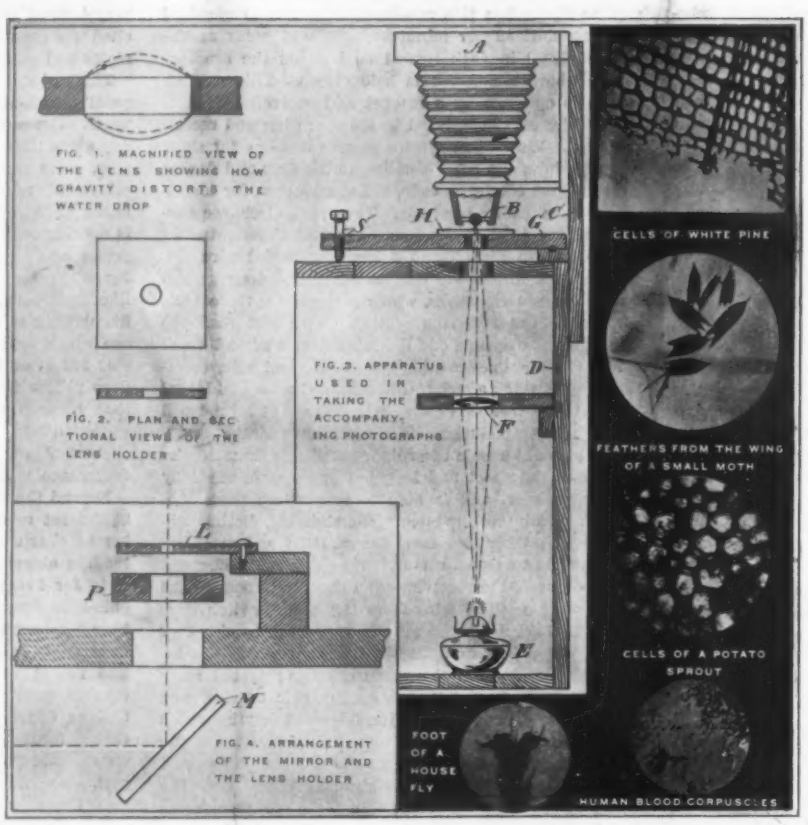
The model is 18 feet 6 inches long by 12 feet wide, representing an area 5,315 feet long by 3,478 feet wide. There are more than 500 structures represented in the model, including loading bins, dwelling houses and other buildings. After experimenting with wood, plaster, and other materials, the metal buildings, which are corrugated iron in the field, were made of brass covered with thin zinc foil scored to represent the corrugations to scale, while the dwelling houses and some small structures were made of cardboard. The head frames, loading bins, railroad tracks, etc., were made of brass.

The museum men in the field made records even of the color of paint on the different buildings, the nature of the material used in construction, the shape and character of the roofs, the position and nature of vines, shrubs, and trees, and in fact all other features that would be useful in making a naturalistic reproduction of the portion to be represented.

Originally it was intended to represent only the surface, with a painted background showing the Mule Mountains, but as soon as the work was actively begun it was considered of utmost importance that the underground workings should be represented as well. It was decided, too, to make a working model of a single stope on a scale of six feet to the inch to represent details that could not be indicated on the big model.

The representation of the underground work could be accomplished only by excavating the under portion of the model, and to place in the hollows thus formed reproductions of the stopes in solid wood, cut according to detailed plans of the levels as furnished by engineers of the company. Tunnels, raises, winzes, and shafts were likewise constructed to scale according to these plans and inserted in their proper places.

The sides of the model were used to give the geological sections along several vertical planes from 4,100 to 5,900 feet above the sea.



Water-drop microscope and photomicrographs made with it.

At work on the copper mine model of the American Museum of Natural History.

The Water-drop as a Microscope

By James Bailey

THAT a drop of water has the power of magnifying a hundred diameters astonishes most of us, and yet we are familiar with the properties of water, which make it suitable for a lens. We know that, when free, a drop of water assumes a spherical shape, we know that a lens is formed by grinding glass so that it has spherical surfaces, also that water like glass has the power of bending light rays. A free drop of water, therefore, has the two main properties of a lens, i. e., spherical surfaces and refraction. A free drop of water, however, is useless as a lens, but by a suitable holder the lens qualities of the liquid can be maintained and the drop readily handled.

The theory of the lens is quite simple. Consider the holder shown in Figs. 1 and 2, and neglect the effect of gravity for the present. The water or liquid used is prevented from falling out of the holder by adhesion. The surface tension of the liquid causes its surfaces to act like thin sheets of rubber fastened to the upper and lower edges of the holder. These edges being true circles, any pressure from within distorts them into spherical shells as shown by the dotted lines in Fig. 1. If the space between these is filled with water a lens is formed. The effect of gravity is to lower both surfaces and to distort them from the true spherical shape as shown by the solid lines. This corresponds to the actual condition and approximates the shape of the liquid lens as used. It can be easily shown that this distortion increases with the diameter of the holder, and as more liquid is added to

(*Concluded on page 294.*)

Model of an Arizona copper mine in the American Museum of Natural History.

The surface of the ground was modeled in clay on a wooden core. Many photographs had to be taken on the spot in Arizona so that every detail could be accurately reproduced.

Finishing the Work at Panama

WERE it not for the troublesome slides, the Panama Canal would to-day be a completed task; indeed, had it not been for the Cucuracha slide, the work of excavation would have been completed and the canal would have been made ready for opening at least one year before the time officially set for that event, namely, January 1st, 1915. In speaking of the Cucuracha slide, it must not be forgotten that this vast earth movement represents, after all, but a small part of the total amount of excavation that has been added to the original estimated amount by the earth and rock movements along the canal, and chiefly in the great Culebra cut.

To realize the magnitude of the task superadded by the slides, we must remember that it cannot be measured merely by the total yardage which has had to be removed. This in itself is large enough, Heaven knows, for it has reached the enormous total of 30,000,000 cubic yards, the removal of which in itself would constitute an engineering feat of the first magnitude. We must remember that in addition to the mere work of removal, the slides have imposed other burdens, due to their interference with the operation of the enormous excavating and removal plants, which have covered the bottom of the cut at all times during the progress of the work.

Frequently the slides have moved entirely across the cut, burying the tracks, filling up the drainage ditches, breaking the pipe lines for conveying air to the air drills, and otherwise upsetting the whole material organization.

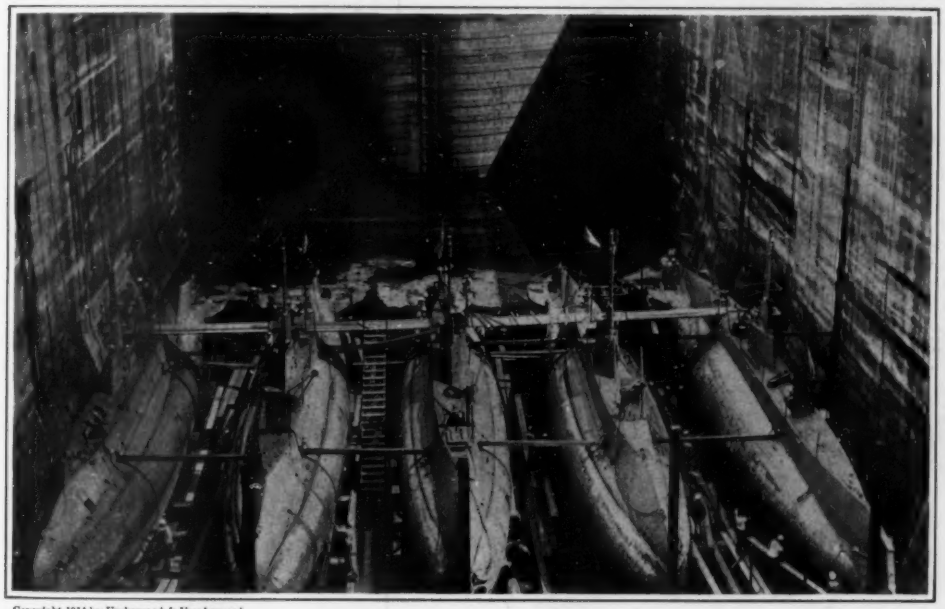
Nevertheless, in spite of these interruptions and in spite of the enormous additional burdens of excavation imposed, it has to be recorded to the eternal credit of the engineers they have succeeded in steadily lowering the cost of excavation. This reduction in cost has been so great that it has about covered the increased cost of removing the slides.

At the present writing a channel about 200 feet wide has been opened past the Cucuracha slide, and, as will be seen from our illustration, the dredges and the hydraulic monitors are steadily at work, the former removing the material from the toe of the slide, and the latter sluicing it away from the upper levels. According to the latest reports, Col. Goethals expects to have the channel so far cleared that it will be open for experimental navigation by ocean-going steamers on the first of July of the present year. The intervening time between that date and the day of official opening will be devoted to the drilling of the operating forces and getting everything into thorough working order; so that when the canal is opened to the commerce of the world, both the machinery and the operating forces may move with precision and a complete absence of delay.

The construction of the fortifications at each end of the canal is nearing completion and the mounting of the mortars and long-range rifles will probably be begun during the coming summer. Recently five submarines were dispatched to the Atlantic end of the canal to form part of the permanent defenses. Shortly after their arrival, the little craft were drydocked for overhauling and cleaning. Drydocks are being built at each end of the canal; but as these were not available, use was made of one of the locks at Gatun, and the submarines were docked side by side as shown in our illustration. So far as we know, this is the first time that locks have been used for this purpose.

Copyright 1914 by Brown & Dawson

Completed locks at Panama, showing at left an electric towing locomotive.



Copyright 1914 by Underwood & Underwood

One of the Gatun locks serving as a drydock for submarines.

A New Method of Sterilizing Milk

A NEW German invention for producing germ-free milk, known as the "biorisator," is said to be in successful use at dairies in Leipzig and Düsseldorf, and a favorable report upon it has just been made by W. Freund, who has investigated it on behalf of a German association of wholesale milk dealers.

The advantage claimed for the biorisator process, as a substitute for the ordinary methods of pasteurization and sterilization, is that while it insures the destruction of pathogenic germs, it produces no change whatever in the chemical composition of the milk. The latter retains all the properties of raw milk, and can be used for cheese making, besides keeping much longer than either raw or pasteurized milk.

The essential features of the process are that the milk is poured into a pressure chamber, where it is subjected by a pump to a pressure of 4 atmospheres; it is then conveyed by the same pressure to a large cylindrical vessel, which it enters in the form of a fine spray, and is, at the same time, subjected to a temperature of 167 deg. Fahr. From the cylinder it passes through a cooler, where its temperature is rapidly lowered to at least 50 degrees. From this it flows to a bottle-filling machine. The peculiar merit of this process appears to be that the milk is subjected for only a brief time to the sterilizing temperature while in the form of a spray. Another advantage is that no milk is lost by evaporation.

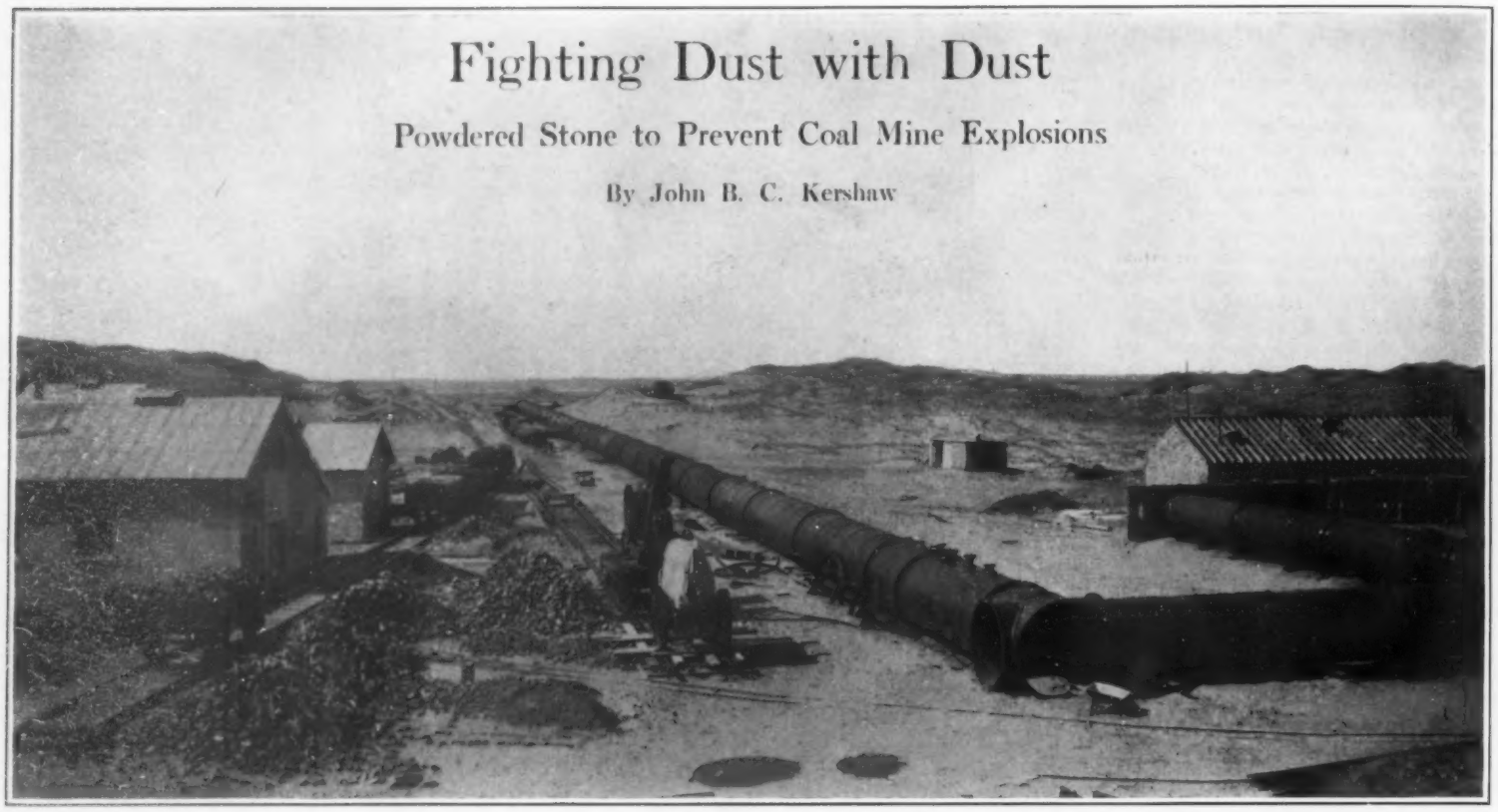
Copyright 1914 by Brown & Dawson

Dredges at work removing the Cucuracha slide.

Fighting Dust with Dust

Powdered Stone to Prevent Coal Mine Explosions

By John B. C. Kershaw



General view of the Experimental Explosion Station, showing the 7½-foot gallery.

THE SCIENTIFIC AMERICAN SUPPLEMENT of August 23rd last, contained the reprint of a paper upon the "Effects of Incombustible Dusts on the Explosion of Gases," read by Prof. Harold B. Dixon, F.R.S., and Colin Campbell, M.Sc., before the Manchester (Eng.) section of the Society of Chemical Industry. The investigations described in this paper had their origin in the proposal to use stone or slate dust in coal mines, in order to minimize or prevent the dangerous explosions of coal dust, which have been proved to add greatly to the devastating effects of fire-damp explosions in dry and dusty mines. The objection had been raised (based on some experiments carried out by Sir Frederick Abel in 1881-1882) that incombustible dust such as stone or slate dust would *add to*, rather than *minimize* the dangers of explosion in mines, because catalytic action would come into play, and would accelerate the rate of the chemical combustion of the carbon-monoxide or methane with the oxygen of the air.

The investigations referred to by Dixon and Campbell proved conclusively that Sir Frederick Abel had drawn wrong conclusions from the results of his experiments in 1881-1882, and that the presence of incombustible dust in a mine, so far from accelerating the rate of combustion, exerted a cooling and quenching effect on the flame. The use of such dusts in coal mines cannot therefore add to the danger or intensity of fire damp explosions.

Since Dixon and Campbell's paper was published, the fifth report of the Explosions in Mines Committee has been published,[1] and as this contains very important recommendations and proposals regarding the use of stone dust in mines, certain of the "*conclusions*" arrived at by the committee are given below:

"A slowly traveling inflammation, such as is produced when a ready-made dust cloud is ignited by a large jet of gas (unaccompanied by concussion) is at first capable of licking up coal dust deposited upon the surface of an incombustible dust and propagating itself for some distance until sufficient violence is developed to raise the incombustible dust also; and this raising of the incombustible dust is more readily effected when a lighter or more buoyant dust, such as flue dust or fuller's earth, is employed, both coal and incombustible dust being raised in suspension together, and the flame soon dying down."

. . . . . .

"Incombustible dust is more effective in preventing the ignition of coal dust than in checking an inflammation that has started. It should, therefore, be distributed uniformly throughout those galleries of the mine subject to the danger of coal dust ignition, and if maintained in the proportion of between one and two parts by weight of incombustible dust to one of coal dust, the chances of such ignition taking place would be very small. Even a small proportion of incombustible dust (20 or 30 per cent by weight) has a marked effect in checking an incipient inflammation.

"The disposal of incombustible dust in zones, or in easily disturbed masses concentrated in certain positions, leaving portions of the roads untreated, *is, we think, not likely to be effective.*

"In the case of mild inflammation, an incombustible dust that is readily raised and floats in the air, has been found to be more effective than one which, owing to its shape or density, is less buoyant.

"Shale dusts, or even heavier dusts, such as sand, are, however, effective, when sufficient violence has been attained to raise them in suspension in the air."

Having thus formulated the conclusions, which appear to follow from their experiments at Eskmaels and elsewhere, the committee make some practical suggestions, and here again it will be best to quote their report:

"It must be distinctly understood that our experiments have traversed, as yet, only a portion of the subject, and that what we propose is advanced as a provisional precaution which may be found on further experience to need extension. But since these experiments have clearly shown the great difficulty of initiating an explosion in a gallery where the coal dust has been mixed with an easily raised incombustible dust, so that the mixture contained at least 50 per cent of incombustible material, we are confident that the dust in a mine so treated would be relatively safe from ordinary ignitions, and consequently that the chance of a *disastrous explosion would be greatly diminished.*"

. . . . . .

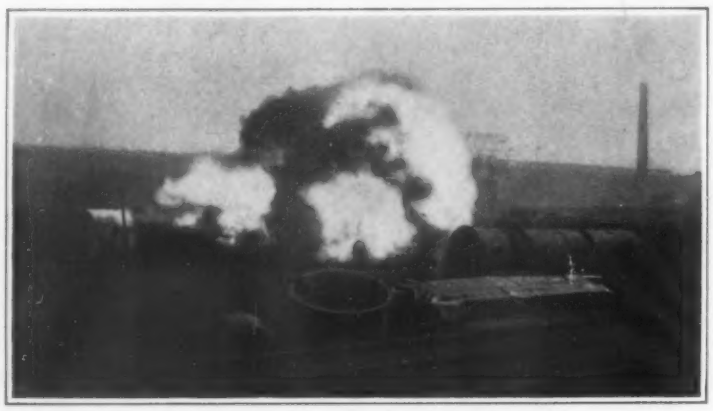
Since this admixture with 50 per cent of incombustible matter, which can be carried out in a simple and practical way, confers on coal dust such power of resisting inflammation, it might be, in our opinion, most *usefully adopted now, even if further experiments may lead to extensions, or other methods be found more efficient.*

We think therefore that, as an alternative to watering, the treatment of coal dust by an incombustible dust—so as to maintain an excess of incombustible matter in the mixed dust—might be adopted as fulfilling the requirements of the English Coal Mines Act of 1911.

By Section 62 (3) and (4) of that Act it is enacted that:

"The floor, roof and sides of the roads shall be systematically cleared so as to prevent, as far as practicable, coal dust accumulating; and . . . systematic steps, either by way of watering or otherwise . . . shall be taken to prevent explosions of coal dust occurring or being carried along the roads. Such a systematic step

(Concluded on page 294.)



Free end of the gallery during a test.

Junction of the 7½-foot gallery with one 3 feet 2 inches in diameter.

[1] Cd. 7,132. Date, October 22nd, 1913.

Curiosities of Science and Invention

Wrecked by a shifting foundation.

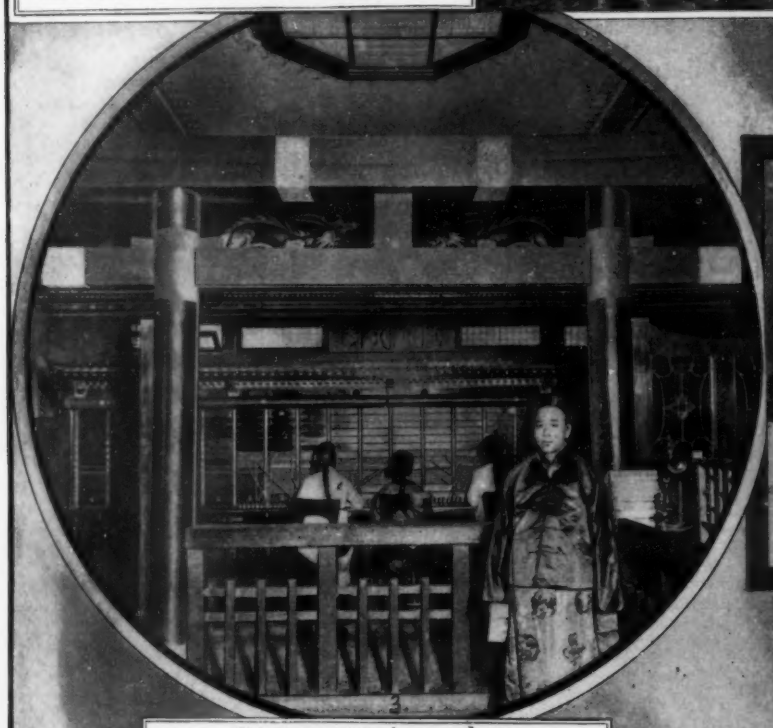
Theater building in course of erection in Victoria, Vancouver Island, had its foundation laid in blue clay. This proved to be a pocket in "made" land, and it shifted one night under the weight of the heavy brick walls. The displacement was only one foot, but this was sufficient to ruin the entire structure.

1.

Motorcycle chemical fire-engine.

There has recently been developed in Oklahoma City a novel emergency fire-engine, consisting of a regular motorcycle equipped with two chemical tanks on either side of the rear wheel directly back of the driver's seat. This equipment can be brought into action more quickly than an automobile fire-engine.

2.



Chinatown's telephone exchange.

The most remarkable feature of the Chinese telephone exchange, located in the heart of San Francisco's Chinatown, is the fact that the Chinese girl operators know not only every number, but the corresponding name of every one of the 1,500 Chinese subscribers. The Chinatown branch has a Chinese manager, Mr. Loo Kum Shu.

3.

Front drive tricycle motor car.

The idea of using a front drive in motor cars dates back to the very earliest days of the automobile, when efforts were made to use the motor in front of the vehicle as a substitute for a horse. Now, apparently the idea is being revived, as may be noted in the recent photograph.

4.

Courtesy of the Bureau of Surveys, Philadelphia

Uniform distribution of sewage in a filter.

Ordinarily in a filter bed using fixed nozzles, most of the sewage is distributed in a ring around each nozzle. In the Pennypack Creek Disposal Works, Philadelphia, the flow of sewage is rhythmically retarded and accelerated by automatic operation of a butterfly valve, so that the bed is uniformly dosed.

5.

Slot machine for the job seeker.

A Los Angeles inventor has installed a "job seeker's" slot machine on the streets. The glass case shows cards stating conditions offered by employers. Dropping a quarter in a slot releases the corresponding card, which bears the employer's address on the back. If he finds the job taken, the quarter is refunded by the firm operating the machine.

6.

ODDS AND ENDS FROM THE EDITOR'S DRAWER.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

WAISTBAND LINING FOR TROUSERS.—A. A. BROWN, care of A. L. Palmer Co., 313 Lafayette St., N. Y., N. Y. By means of this invention linings of trousers are sewed entirely by machine, thus doing away with the necessity of placing the work outside the factory, in homes, as is the custom. These advantages accrue from a novel construction of waistband lining which can be quickly made and attached to the garment, and at the same time present a neater appearance than do waistbands sewed to trousers by hand.

TAILOR'S RULE.—M. CARROLL, 196 Madison St., New York, N. Y. This invention relates particularly to rules for tailors' use and for ruling off garments or patterns, and it provides a structure in which the various measurements have been arranged in systematic order so that a proper pattern may be cut with a minimum amount of measuring.

ARCH SUPPORT FOR SHOES.—P. IACOVINO, 199 Prince St., New York, N. Y. An object here is to provide a support which may be applied to any footwear and at any time. The support is provided with suitable bracing members for supporting the arch of the foot, the entire structure being also formed so as to be readily inserted in a shoe after its completion.

Electrical Devices.

ELECTRICAL FURNACE.—C. C. WHITMORE, 104 E. First St., Butte, Mont. The advantages in this case are: The utilization of the current in two ways, to wit, in heating electrodes and in heating ores and substances intermixed therewith by conductivity thereof. To prevent overheating of electrodes. To control distribution of ores or other materials upon which the furnace operates, a greater amount of material being passed into the furnace at points where the heat thereof is comparatively great. To enable a group of electrodes to be readily removed relatively to another group thereof for purposes of distributing the current.

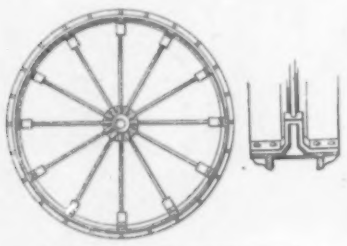
SIGNALING DEVICE FOR PARTY LINE TELEPHONES.—T. KERNAN, 428 Fifth Ave., N. E. East St. Cloud, Minn. The improvements in this case indicate to a user of the telephone whether a person other than the party with whom he desires to talk has taken down or put up his receiver, and also indicates the identity of the party who is listening in. It may readily be attached to instruments of the ordinary type without interfering with the circuit.

Of Interest to Farmers.

AUTOMATIC HOE.—A. THOMPSON, 122 Jefferson St., Spartanburg, S. C. This invention relates to agricultural machinery, the more particular purpose being to produce a hoe having a number of advantages and adapted for use in a variety of different relations, being of special service in connection with the cultivation of cotton.

BEET BLOCKER.—H. W. GRIBLER and A. G. GRIBLER, 741 Prospect Ave., Van Wert, Ohio. The purpose here is to provide a beet cultivator especially adapted for cultivating beets in the field in the opposite direction from the direction of the beets in the row, and wherein mechanism is provided for protecting the plants during the cultivating operation.

TRACTION WHEEL FOR PLANTERS.—E. J. ODGEN, Springfield, Ill. This application is a division of the application Serial No. 664,000, filed Dec. 5th, 1911, patented Nov. 25th, 1913, No. 1,079,797, and the invention relates to traction wheels for corn and other planters.



TRACTION WHEEL FOR PLANTERS.

The object of the present invention is to provide a wheel with means which will straddle the hills of corn or other seed, or which can be made a traction wheel by closing the space between the ribs as shown in the smaller engraving. A further object is to provide a wheel with means which will effectually prevent it from slipping.

STRAW STACKER.—J. MASERANG, 6653 Manchester Ave., St. Louis, Mo. The object here is to provide a stacker of the blower type, wherein mechanism is provided in connection with the stacker for permitting straw as it issues from the stacker to be directed to any parts of the stack, the said means being operated from the threshing machine.

ELEVATOR.—E. H. ZIMMERMAN, P. O. Box 67, Perry, Ill. The purpose here is to provide an elevator which may be transported from place to place and may be operated from any suitable source of power, and which is especially adapted for handling grain, such as corn and wheat, vegetables, such as potatoes or any other article that can be handled with a scoop shovel.

EVENER.—R. H. KEITH and F. H. BROOKS, Rowan, Iowa. Address the former. The patent provides a device especially adapted for use with farming implements of the drag class, especially of the folding type, and so arranged that the evener may be folded with the drag, in passing through gates or narrow passages.

Of General Interest.

SHAVING BRUSH.—H. ROBINSON, 1 First Ave., Winfield, N. Y. The principal object here is to provide a collapsible handle having a tubular portion to form a pocket for the brush tuft, and to construct the handle or mounting to form a box-like casing, the ends whereof are closed to prevent the admission of dust to the tuft and to prevent the tuft moistening surrounding surfaces.

HOLE CLOSURE.—D. J. DIEL, 3614 Rockaway Road, Woodhaven, L. I., N. Y. Among the objects particularly aimed at is to provide a cheap reliable metal closure which may be quickly secured in place, substantially closing the hole or opening, but which may be removed with facility by a suitable simple tool, when necessary, for reopening the hole.

ANVIL ATTACHMENT.—J. R. STULL, 1121 South Los Angeles St., Los Angeles, Cal. This invention provides an attachment for an anvil having an arm, which extends through an opening in the top of the anvil, the arm being provided with a head, which projects longitudinally of the anvil at opposite sides of the arm, the last being pivoted to a lever, fulcrumed to the anvil block, so that this lever may be operated by the foot of the smith, to conveniently clamp the member between head and anvil.

OPTICAL INSTRUMENT.—W. WORK, care of H. S. Hewett, 119 Main St., Brockton, Mass. The inventor provides an instrument to be used in conjunction with a plano-retinoscope, and arranged to permit of quickly and accurately determining the amount of refraction of the eye of a patient under observation by an oculist or other examiner, to insure fitting the patient with eyeglasses or spectacles having correct spherical, cylindrical or compound lenses.

ELEVATED CARRIER.—F. L. PUTNAM, Lihue, Hawaii. This invention pertains to elevated carriers and has particular reference to apparatus adapted for various uses such, for instance, as gathering various commodities over a field or wide scope of operation, and conveying the same to a distant point for delivery or deposit.

COMBINED CAMERA CASING AND FILM CARRIER.—R. R. LIVINGSTON, Clermont, N. Y. This invention relates to photographic cameras using roll films, and its aim is to provide a combined camera casing and film carrier arranged to permit carrying extra films without

COMBINED CAMERA CASING AND FILM CARRIER.

increasing the size of the camera casing, and to allow convenient removal of a roll film from the film carrier whenever it is desired to use such film in the camera or for storing the exposed roll film in the carrier.

AUTOMATIC CLOSURE DEVICE FOR LUBRICATORS.—F. BLED, Versailles, Seine et Oise, France. The characteristic qualities of the apparatus consist in the features that the operations of opening and closing are very rapid, that it completely uncovers the lubricating orifice, that it is absolutely tight, and that by reason of its method of fitting it prevents the entrance of dust when it is open and that, moreover, no throwing-out of oil takes place when it is closed.

PROCESS FOR MAKING PHOTO-STEREOTYPES FOR TYPOGRAPHIC PRINTING PRESSES.—C. BAECHLER, Lompoc, Cal. In this instance the invention has reference to the process of making printing blocks directly from any negative or film, by employing bichromated gelatin or glue, and a screen or chemical grain to form the printing block.

OPERATING TABLE FOR USE IN ANIMAL RESEARCH.—KATHARINE STEBBINS, 437 W. 59th St., Manhattan, N. Y., N. Y. The table is constructed with posts having hooks at their upper terminals, which engage eyes of adjustable leaves which rest on cross-bars supported on screws which mesh in threaded openings in the table, so that by turning the screws the cross-bars may be raised or lowered, carrying with them the leaves. The sides of the leaves are curved over the lugs, which permits the movement of the leaves without interference by the hooks on the posts.

WIRE FENCE STRETCHER.—T. R. G. SMITH, Warren, Ark. In this invention use is made of a jack screw operated by a T-handle similar to the handle of the common bench vise, and an elongated tubular base that is threaded internally to secure the jack screw, and bears against the post to which the fence wires are to be secured. The wires are received in and gripped by a standard, which is connected with the jack screw through the medium of a yoke that is adjustable to different heights on the standard, and is swiveled to the jack screw.

COLLAPSIBLE TRUNK.—B. L. URDANG, 11a W. 118th St., New York, N. Y. Among the special objects of the invention is to produce a trunk so as to be strong, rigid and durable in use for shipping or storing purposes and adapted to be collapsed when empty and with all of the parts substantially inclosed between the bottom and the lid.

BURGLAR ALARM.—J. HOFMANN, 157 E. 55th St., Manhattan, N. Y., N. Y. Use is made of a barrel having a closed upper end forming an anvil against which a detonating cap is to be exploded, the barrel being adapted to be suspended from one end of a cord having

BURGLAR ALARM.

its other end clamped in place by the movable object at the time the latter is shut, so that on opening this object the cord is released to allow the barrel to drop. Use is also made of a screw cap and a firing pin slidable in the barrel and screw cap and projecting below the screw cap, the pin being adapted to carry a detonating cap to be exploded against the upper end of the barrel at the time the barrel drops and the pin strikes the floor.

HORSESHOE.—G. STAPLES, Oshkosh, Wis. The present invention relates to horseshoes and is an improvement in that class of horseshoes provided with a resilient cushion or pad and with removable calks, the object being to provide certain novel details in the construction and arrangement of the several parts.

REFRIGERATING APPARATUS.—W. A. OWEN, Johnson City, Tenn. In carrying out the present invention, it is the inventor's purpose to provide a refrigerating apparatus whereby articles or eatables such as meats and the like of a perishable nature, may be kept cool and by means of which the operation of making ice may be carried on.

SUPPORT.—W. A. POWEL, 108 E. Main Cross, Taylorville, Ill. The support is designed for holding the pipe sections of the water main in position in the trench for conveniently joining adjacent sections, and for pouring the lead into the bell or spigot joints a distance above the bottom of the trench to avoid cutting bell holes for leading and calking purposes, the support being arranged to permit of gradually lowering the united pipe sections to their final resting place in the bottom of the trench.

HORSESHOE CALK.—F. F. HEISELMANN, Cox Place and Edwards Rd., Hyde Park, Ohio. This invention refers more particularly to the combination with a horseshoe provided with a recess, of a calk having a point and a head adapted to be received in and fit into the recess, and a keeper co-operating with the calk and recess of the horseshoe to secure the calk against accidental displacement.

BASKET.—M. J. WHEELER and F. B. FOSTER, Peterboro, Hillsboro Co., N. H. This improvement relates more particularly to a fruit or vegetable basket, and it is a design of the invention to provide a basket by which the fruit or vegetables may be handled and dumped from the basket without injury and with convenience.

POST OR POLE.—J. M. BOOTH, care of Evans State Bank, American Falls, Idaho. The object in this instance is to provide a metallic post which may be quickly and economically formed, which will effectually receive and hold longitudinal fence wires and thus be adapted for use as a fence post, and which may be driven into the earth and rigidly maintain itself in position.

SHAVING CREAM.—P. C. MAGDLEN, 63 W. 107th St., New York, N. Y. The object in view is to provide a composition adapted to be used on the face in place of an ordinary shaving soap, which will soften the beard and allow the razor to be used in the usual manner while combining with such characteristics the usual characteristics of a good quality of face cream.

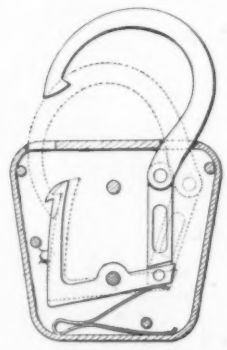
METHOD FOR LOCATING THE PLACE AND CHARACTER OF A LIQUID COMING FROM STRATA IN A WELL.—T. A. BEECHER, Box 352 Drumright, Okla. The object here is to determine and locate strata containing liquids when drilling a well or in a drilled well. The inventor employs proper coloring matter, placed in a predetermined position in the well, and then the liquid from the well is gradually discharged and analyzed to ascertain if the so discharged liquid contains the coloring matter. Mr. Beecher has invented another method in which he employs proper coloring matter diffused in a predetermined place in the well, then displacing the colored liquid from the well, and then getting samples of liquid from different depths in the well and ascertaining if the samples contain any of the coloring matter diffused.

PROCESS OF MANUFACTURING COMPOSITIONS OF MATTER.—L. LILIENFELD, Zeltgasse 1, Vienna, VIII, Austria-Hungary. This invention relates to improvements in the process of manufacturing compositions of matter by means of heating a drying oleaginous substance with an aromatic substance in the presence of a condensing agent, as described in the applicant's prior patent, No. 1,037,158.

LETTER BINDER.—C. E. O'NEILL, care of First National Bank, Butte, Mont. An object here is to provide a binder of any suitable size which is adapted to embrace all of the sides and ends of the package, and which automatically accommodates itself to the size of the package, making it easy for the binder to be manipulated for the purpose of receiving or delivering letters on other parts to or from the package.

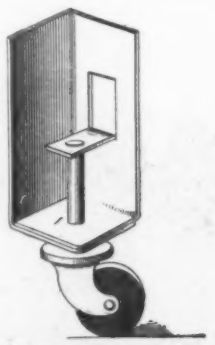
Hardware and Tools.

PADLOCK.—J. SUKUP, 603 Munkivitz Ave., Cudahy, Wis. The padlock represented in the engraving is one difficult of manipulation for opening, except by one familiar with its construction and operation. The padlock may be unlocked by manipulating the shackle from the outside, but may not be unlocked by a key or other instrument, the lock, however, being provided with a key hole so as to present the appearance of an ordinary padlock and thus mislead unauthorized persons attempting to pick the lock, into believing it to be one of usual construction.



PADLOCK.

DEVICE FOR MOUNTING CASTERS.—C. J. BELL, 834 Twelfth St., Miami, Fla. Mr. Bell's invention relates particularly to the legs and casters of such cots, bedsteads, or other articles as are made of angle iron, or at least the legs thereof. An object of his invention is to provide caster bearings formed integrally with the sides of the angle iron legs, thereby to provide a simple and strong construction. The engraving gives a perspective view, showing the lower portion of an angle iron leg embodying the improvement.



DEVICE FOR MOUNTING CASTERS.

WRENCH.—W. CARMAN, 6 Liberty St., Ellenville, N. Y. This invention has reference to a wrench of the quick-acting type, wherein a movable jaw is locked with respect to the shank or handle bar by a pawl or toothed lever which

in held in engagement with the teeth on the shank during use of the wrench.

MORTISE LATCH AND LOCK.—A. C. CHESLEY, 277 Rider St., Bronx, N. Y. In the present invention the object is the provision of a new and improved mortise latch and lock, more especially designed for use on fireproof swing doors and hollow metal casings, and arranged to provide multiple locking contents in a simple and effective manner.

SAW SET AND JOINTER.—A. DUDGEON, 617 Spring St., Latrobe, Pa. This inventor provides a saw set and jointer which will set a number of teeth at a time, in which the tooth bit can be set at different sizes of saw teeth, and in which the motion of the setting tool is adjustable and which, also, is adapted to receive a file for jointing the saw.

PENCIL SHARPENER.—O. W. NIEDOMANSKI, 721 Rock Creek Road, Washington, D. C. This improvement has reference to pencil sharpeners of the type suitable to be carried in the pocket and easily handled, the more particular purpose being to increase the efficiency of the sharpener while promoting the simplicity of the construction thereof.

Heating and Lighting.

MECHANICAL MATCH LIGHTER.—E. D. FITZPATRICK, 408 Paxton Block, Omaha, Neb. The inventor provides a time-released mechanism to ignite a match by abrading the head thereof; provides an alarm clock with means for lighting a match by abrasively engaging the head thereof; and provides a clock mechanism with means for holding a match in operative position, and with means for igniting the same by abrading the head thereof when released by the clock mechanism.

FUEL APPARATUS.—J. HYDE, deceased, care of Catherine Hyde, administratrix, 315 Summit Ave., Mt. Olive Station, Pitt, Pa. This invention relates to apparatus for adapting coal and other like fuel for efficient combustion in a finely divided state, admixed with air, and it refers more particularly to apparatus of the class described, which comprises a casing having a fuel inlet and an outlet, a rotary comminuting device in the casing, and a blower for drawing air in the casing, and forcing the fuel mixture through the outlet.

Household Utilities.

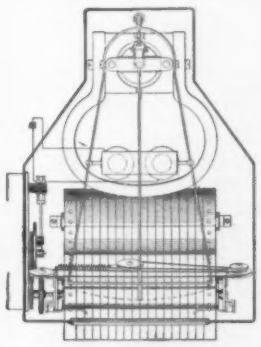
BED COOLER OR HEATER.—G. F. SHEPARD, Box 51, Dodge City, Kan. This device is formed of a pair of similar receptacles having ordinarily the length of an average human body, which can be positioned longitudinally, or otherwise, in a bed, each of said receptacles having means whereby it can be made a cooler or a heater.

Machines and Mechanical Devices.

VIEW CHANGING DEVICE.—W. C. UPP, 30 Church St., New York, N. Y. This invention has reference to view changing devices and has particular reference to means for exhibiting cards, pictures or the like, in such manner as to provide an automatic change from one view to another at regular intervals.

THREAD CUTTING ATTACHMENT FOR SEWING MACHINES.—R. L. COLEY, Kannapolis, N. C. Address J. W. Cannon, Concord, N. C. The purpose here is to provide a mechanism adapted for connection with certain types of sewing machines, for automatically clipping the thread between succeeding pieces of work, as each piece is completed, and wherein means is provided for retaining the operation of the cutter during the passage of the work beneath the needle.

RECORDING MECHANISM.—H. W. PAYNE, 65 Hobart St., Rochester, N. Y. This invention relates to recording mechanism designed especially for recording delicate and accurate measurements or quantities such as volts. An object is to improve this class of devices whereby the operation thereof with respect to the



RECORDING MECHANISM.

galvanometer is practically frictionless, and hence more delicately accurate than devices usually employed for this purpose. A further object is to arrange and construct an instrument which is adapted for making variable records upon a chart having rectangular coordinates whereby such records are more easily and reliably read than when made on other forms of charts.

FRICTION CLUTCH.—N. J. WIGGINTON, Winchester, Va. This improvement provides a friction clutch which will transmit to a machine a given amount of power, and which, when the load on the machine increases beyond a certain point will turn idly, thereby obviating any danger of injury to the machine, such as might occur if the clutch were not used.

ELEVATOR INDICATOR.—F. A. BOEDTCHER, Bergenfield, N. J. This invention is adapted to automatically operate for indicating not only the floor at which the elevator may be positioned and the progress of the elevator from one floor to the other, but to indicate the direction of travel of the elevator regardless of whether or not the same is moving or stationary, so that a person looking at the indicator may observe whether the particular elevator is making an up or down trip.

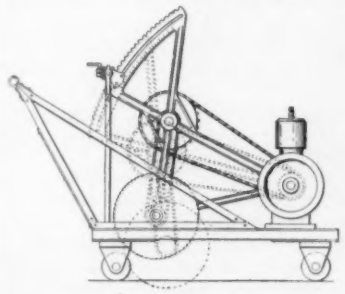
RESUSCITATING APPARATUS.—C. M. HAMMOND, Memphis, Tenn. This inventor provides a casing which may be placed over the body of a patient, and through which the arms, neck and legs may project. This casing forms an air space which may be relieved of the external air pressure, thereby causing the air within the lungs to expand and a rush of air through the air passages into the lungs, similar to the movement of air caused in natural breathing.

ADJUSTABLE CRUSHER HEAD.—E. L. PEMBERTON, 15 Livingston St., New Haven, Conn. This invention relates to crusher heads which may be used for rock and other similar crushers, and which are customarily mounted on a main shaft. These heads are usually manufactured from cast manganese steel to provide the necessary hardness, but as crusher heads when made of this material work loose on the shaft, the present improvement provides means for adjusting and tightening the crusher head on the shaft from time to time.

PUMP CYLINDER.—L. G. EDDY, Huntington, N. Y. In this case use is made of a sleeve extending into the lower end of the pump cylinder and provided at its lower end with a screw thread, a screw, a coupling removably connected with the sleeve, and a packing on the sleeve intermediate the said pump cylinder and the said coupling.

MEASURING MACHINE.—A. F. NIMS, Philadelphia, N. Y. The purpose of the invention is to provide a machine by means of which the respective positions of the mixtures can be easily regulated, and in which obstructions or bodies too large to pass through a hopper are automatically removed without injury to the machine.

MACHINE FOR CUTTING PAVING.—G. PERKINS, 511 E St., N. W., Washington, D. C. This invention relates to a machine for cutting asphalt and other paving through the use of a power-driven circular saw, the object being



MACHINE FOR CUTTING PAVING.

to provide a machine including means by which to support a circular saw in such manner that it may be adjusted toward and away from the ground and held in selected position for cutting the paving or other material to a desired depth.

ILLUMINATED CLOCK.—A. MORINA, 122 Stone St., Newark, N. J. To illuminate a clock, this inventor arranges a holding means for a small lamp, and a chamber between the clock works and the dial. A side door affords access to the lamp chamber. An extinguishing device is actuated at a predetermined hour by an adjustable trip, turning with the hour hand arbor.

LOOM FOR WEAVING ORIENTAL KNOT PILE FABRICS.—J. K. DALKRANIAN, care of M. N. Costikyan, 200 Fifth Ave., Manhattan, N. Y., N. Y. This invention relates to pile fabric looms such as shown and described in the application for Letters Patent of the U. S., No. 265,886, filed by Mr. Dalkranian on June 19th, 1905. The object is to provide a pile fabric loom more especially designed for weaving pile fabrics of the oriental rug type, and preferably such having Persian knots and a reinforced body, as shown and described in the application for Letters Patent of the U. S., No. 312,143, filed by this inventor April 17th, 1906.

POPCORN VENDING MACHINE.—G. A. LIGHTNER, Olustee, Okla. This invention relates more particularly to a vending machine in which fresh corn is fed to the heated popping drum, popped for a predetermined time, salted, and delivered to the purchaser in a definite sequence of operation, all of the mechanisms being actuated by a coin-controlled device.

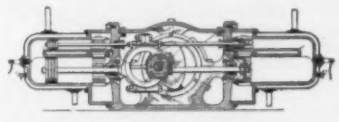
ATTACHMENT FOR ALARM CLOCKS.—E. H. PRATT, Lompoc, Cal. The object of this invention is to provide such releasing means as may be wholly mounted on the exterior surface of the clock without necessitating ingress or connection within the same, which is brought into operation by a friction clutch member disposed upon an exterior portion of the alarm winding arbor and adapted to engage the same when it is turned in one direction only.

HUB-FACING ATTACHMENT FOR CAR WHEEL BORING MILLS.—F. V. MCDONNELL, care of M. P. Lines, W. of Pittsburg, Logansport, Ind. The general object of the invention is to provide an attachment whereby the feed screw for the facing cutter can be power-driven so as to relieve the operator of the work of turning the screw, it being merely necessary for the operator to initially adjust the facing cutter and then interrupt the feed of the latter when the cut has been completed.

Prime Movers and Their Accessories.

ENGINE.—J. H. RICHARDSON, Verdon, Neb. The purpose here is to provide an engine for utilizing the expansive force of fluids, wherein a series of pistons is provided, the central piston moving between the lateral pistons and in opposite direction to the said pistons, and cooperating in alternation with the said pistons as an abutment against which the motive fluid may react.

INTERNAL COMBUSTION ENGINE.—J. W. PITTS, Hotel Stratford, Houston, Tex. This invention provides novel means for ridding the cylinders of the spent gases or products of combustion and for cooling the cylinders. It provides means for doing away with the back



INTERNAL COMBUSTION ENGINE.

pressure on the exhaust, and this is accomplished by means of a device which makes use of the momentum acquired by the gases themselves. It provides a device whereby a plurality of pistons may be connected to work absolutely in unison, and provides a novel form of compression chamber for the explosive charges.

STARTING DEVICE FOR INTERNAL COMBUSTION ENGINES.—D. E. CROUSE, 3 North St., Annapolis, Md. An object of the present invention is to provide a device which may be started from any point by the mere compressing of an electric push button, the subsequent operation of the device serving to start the internal combustion engine and to restore the starting mechanism to its normal position.

Railways and Their Accessories.

BOILER WASHING SYSTEM.—W. M. SAXTON, Spokane, Wash., and C. C. HODGE, Winnipeg, Manitoba, Canada. Address the former, 46 Canada Life Building, Spokane, Wash. This invention provides means whereby the boilers of a plurality of locomotives, each under a different steam pressure, may be blown off simultaneously without one interfering with the other, and any member may be washed out at the same time.

SWITCH STAND LOCK.—C. WOOD, P. O. Box 331, Moulton, Iowa. This device is capable of being applied to existing stands without radical change, by means of which the dropping of the lever into inoperative position after setting the switch to either position will positively lock the switch, that is, will lock the operating lever to the stand. Mr. Wood has invented another switch stand lock which provides means in connection with a switch stand for locking the operating lever to the stand, with the switch in open or closed position, wherein the locking means is actuated by the dropping of the operating lever into inactive position.

SAFETY SWITCH POINT.—J. B. COBB, Jr., 611 N. Chapman St., Shawnee, Okla. This invention is an improvement in safety switch points, and has for its object the provision of a switch-point of the character specified, wherein the points will be at all times held in normal position regardless of defects in the switch, stand, or the connecting rod.

Pertaining to Recreation.

TOY.—E. LOGAN, 1900 Kater St., Philadelphia, Pa. This toy is adapted to be trundled along the floor by a child, whereby it is adapted to give a succession of rings on a bell attached thereto. An object is to provide a device in which a bell may be sounded by movement of the same in one direction, and whereby said bell will remain silent by movement in the opposite direction.

CAROUSEL.—S. W. BRUNDAGE, care of Charles W. Parker of Leavenworth, Kan. This invention provides useful improvements in merry-go-rounds or carousels whereby a pitching and rolling movement is given to a boat or similar vessel while being bodily carried around, so as to enable the occupant of the boat to enjoy a ride similar to that when aboard a pitching or rolling marine vessel on troubled or disturbed waters.

ANIMATED TOY.—A. GUND, 220 W. 19th St., Manhattan, N. Y., N. Y. This invention provides a toy in doll form or simulating an animal, and is arranged when alternately pressed and released to actuate certain members of the body, such as arms, legs, wings, or the like, and at the same time cause the production of sounds similar to those emitted by the simulated child or animal.

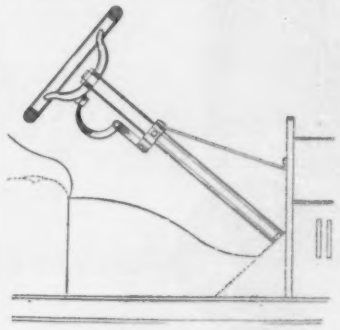
Pertaining to Vehicles.

LOCK FOR AUTOMOBILES.—J. A. CAMPBELL, Carbondale, Ill. The object here is to provide an automobile with a lock, the lock having a bar with a lug which may be moved into engagement with a lug on a foot pedal arm for operating the clutch, so that when the bar is secured with its lug engaging the lug on the arm it will be impossible to drive the automobile.

SAFETY ATTACHMENT FOR AUTOMOBILE CRANKING MECHANISM.—H. C. TUNIS, 54 Wakeman Ave., Newark, N. J. This invention provides means whereby is rendered impossible the ignition compression in engines of automobiles, while the speed gears thereof are in service position; and provides a simple and efficient mechanism for effecting the above-stated operation.

TIRE UPSETTER AND SHRINKER.—J. F. BOYD, Box 25, Bigelow, Ark. This improvement comprises a pair of upsetting blocks mounted to be moved toward and from each other, which carry gripping means for engaging the edge of the tire to crowd or compress the body thereof together, and thus reduce tire circumference to the required extent, and fit more tightly on the wheel. The blocks are positively operated to be moved toward each other to cause the grips to perform the compressing operation, and means are also provided to return them after the operation of gripping, to their original positions.

AUTOMOBILE LOCK.—T. S. KEFFER, 22 N. Raleigh Ave., Atlantic City, N. J. The purpose here is to provide a lock for use in connection with the steering wheels of automobiles and other motor vehicles for preventing movement of the steering wheel by unauthorized persons, which may be applied to the steer-



AUTOMOBILE LOCK.

ing wheel of any motor vehicle, without change in the wheel itself, and which when in operative position will absolutely prevent movement of the wheel, and when in inoperative position will not interfere with the operation of the wheel.

Designs.

DESIGN FOR A SANITARY TELEPHONE MOUTHPIECE.—C. MUNDT, 832 Willow Ave., Hoboken, N. J. In this ornamental design for a sanitary telephone mouthpiece, one figure is a front view of a telephone mouthpiece; another is a rear view of the mouthpiece, and the last is a vertical section through the mouthpieces, part of a telephone being shown in dotted line.

DESIGN FOR A TICKET BOOTH.—W. YAEGER, care of Strauss & Co., 209 W. 48th St., New York, N. Y. In this design for a ticket booth the structure presents an elevation of exceptionally pleasing appearance. Above the base a columned center supports a dome of highly ornamental design, which is crowned by a sphere.

DESIGN FOR A BUST REDUCER BRASSIERE.—S. H. BURNS and C. D. PERILLAT, "Ye Lady's Outfitterie," 15 W. 38th St., New York, N. Y. In this ornamental design for a bust reducer brassière, Fig. 1 is a front view in perspective; and Fig. 2 is a rear view.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Fighting Dust With Dust

(Concluded from page 290.)

as is laid down in the above clause would be taken, in our opinion, if the roads were treated with incombustible dust.

"It should be clearly understood that in recommending this limit of 50 per cent of ash we are putting it forward provisionally and as a minimum."

In closing this brief account of the present position in the United Kingdom with regard to the use of stone dust in mines, a few particulars of the Experimental Explosion Station at Eskmaels, in Cumberland, may be given, also some details of the constitution of the committee in charge of the experimental work.

The experiments were commenced by the Mining Association of Great Britain, at Altofts Colliery, Normanton, Yorks, in 1908. The result of these experiments was to prove beyond all doubt the truth of the theory that coal dust suspended in the air was capable of being ignited without the aid of any inflammable gas, and was, therefore, capable of propagating an explosion through the dusty galleries of coal mines.

The official record of these experiments, and of the conclusion based upon them, is contained in the *Proceedings* of the Mining Association of Great Britain, for the year 1910. In that year, the Mining Association approached the Royal Commission on Mines with the view of ascertaining whether the government would be prepared to continue the experiments at the public cost, and offered to lend to the government the experimental plant and apparatus that they had accumulated at Altofts. This proposal was communicated to His Majesty's government, which ultimately undertook to find the funds necessary for the purpose. An executive committee to carry out the experiments was appointed by the Secretary of State for the Home Department, consisting of Sir Henry Cunynghame, chairman; Mr. R. A. S. Redmayne, Capt. A. H. P. Desborough, Prof. H. B. Dixon, and Mr. W. C. Blackett. The members of the Royal Commission on Mines, together with the Coal Dust Committee of the Mining Association already referred to, were constituted as a Consultative Committee. The first meeting of the Executive Committee was held at the Home Office on May 11th, 1911.

The site at Altofts being no longer available, it became necessary to seek a new one. An endeavor was made to secure a suitable locality which should be at a fairly equal distance from the various coal fields in England, Scotland, and Wales, which should be remote from dwellings, and at the same time should be near a railway so as to afford convenient access for heavy material. After the examination of numerous sites a piece of land on the sea was chosen, near Eskmaels, in the county of Cumberland, adjoining the gun-range of Messrs. Vickers. The works are surrounded by sand hills. The space available for a gallery measures 600 yards in length from the eastern side of the seashore. The large gallery (7 feet 6 inches) has been removed from Altofts, and has been placed east and west, so as to point seaward, and it nows extends to a length of 800 feet.

A smaller gallery, 3 feet in diameter and 400 feet long, has been fixed alongside the large gallery for the purpose of making comparative experiments, and the number of recording instruments for following the course of the explosions has been accordingly increased.

The writer's thanks are due to Prof. Harold Dixon, F.R.S., a member of the Home Office Committee, in charge of the experimental work, and also to Dr. Wheeler, the chemist in charge of the tests at Eskmaels, for their co-operation in obtaining photographs and information for use in this article.

The Water-drop as a Microscope

(Concluded from page 288.)

the lens, thus limiting the diameter of the hole, which can successfully be used to hold the drop, and the magnifying power of the lens possible with any given holder. The magnifying power may, however, be increased by using a smaller holder, since

LEGAL NOTICES

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

AGENTS WANTED

300 to 400% Profit to Agents selling our guaranteed U. S. Fire Extinguishers. Tremendous demand. Orders repeat. Exclusive territory to County and Dist. Mgrs. United Mfg. Co., 1043 Jefferson, Toledo, O.

AGENTS. 500% Profit. Free Sample Gold and Silver Sign Letters for store fronts and office windows. Any one can put on. Big demand everywhere. Write today for liberal offer to agents. Metallic Letter Co., 438 N. Clark St., Chicago, U. S. A.

BUSINESS OPPORTUNITIES

SMALL MECHANICAL DEVICE FOR BINDing sheaves or the like. Used by thousands. Large profits. Can be manufactured very cheaply by specially designed automatic machine, which we will sell with patent rights. For further particulars address J. Weinbrenner & Co., 10 Milk Street, Boston, Mass.

CONTRACTORS, BUILDERS, ATTENTION!

EFFICIENT, LABOR-SAVING and useful earth-dumper or shovel for excavating, fully described in letters patent 1,087,343. Rare opportunity to buy on attractive terms. For particular write Patentee, G. R. Abbott, 1213 Fidelity Bldg., Baltimore, Md.

FOR SALE

CYCLECAR MOTORS, TRANSMISSION, Steering Gears, Hubs, Rims, Spokes, Tires, Parts. Catalogue free. For full particulars address Palmer Bros., Cos Cob, Conn.

HELP WANTED

BE A DETECTIVE. Earn $150 to $300 monthly. Easy work; we show you; open to all; experience unnecessary. Full particulars mailed. Write Wagner, 1243 Lexington Avenue, New York, Dept. 448.

INSTRUCTION

LEARN TO WRITE ADVERTISEMENTS.—Earn $25 to $100 weekly. We can positively show you by mail how to increase your salary. Prospectus free. Page-Davis Co., Dept. 89, Chicago, Ill.

PATENTS FOR SALE

Patent No. 1,010,309, unsinkable rubber boat. Lighter, faster, and yields to shock on account of elasticity of materials used. Great carrying capacity. Joseph Lupiano, 1 So. Main St., Asbury Park, N. J.

SCIENTIFIC APPARATUS

GLASS APPARATUS, thermometers for scientific and industrial laboratories, surgical glassware, experimental work. For further particulars address Laboratory Supply Co., 128 State St., Rochester, N. Y.

INQUIRIES

Inquiry No. 9367. Wanted the name and address of a manufacturer of an automatic centering machine.

Inquiry No. 9368. Wanted, the name and address of glass-bottle manufacturers or glass blowers who can manufacture a glass bottle and perforate it with some 12 small holes, in large quantities for export, to sell at a popular price.

Inquiry No. 9369. Wanted, the names and addresses of users of Indian Steatite (Soapstone), Corundum and other Indian minerals, in quantities.

Inquiry No. 3970. Wanted the names and addressess of manufacturers of small wooden articles, particularly in such soft woods as pine and fir, for articles such as toys, furniture, etc.

Inquiry No. 9371. Information wanted where one could buy or have made to order machine to be used for making solid back brushes.

the surfaces of the drop will be sharper and the effect of gravity is lessened. Very small holders are to be avoided, especially in photographic work, as they let through too little light. Of course it is necessary to use the holder in a horizontal position.

The simplest and best type of holder is that shown in Fig. 2. It consists of a piece of metal about 1/32 inch thick having a straight round hole bored through it at the center. It is of paramount importance that the upper and lower edges of this hole be true circles. The easiest way to insure this is to drill the hole with a first-class twist drill, and then polish both top and bottom surfaces on a flat oil stone. If iron is used it should be blued afterward by heating, to prevent rusting. The best results with this type of holder are obtained with a diameter of from 1/16 inch (having a maximum magnifying power of 100 diameters) to ⅛ inch (having a maximum magnifying power of 60 to 70 diameters).

To fill the holder, a stick with a very long, slender point is best. Dip this stick in the liquid, shake off any surplus, place the point against the inner surface of the holder and allow the desired quantity of liquid to run in. Considerable care must be exercised to prevent any liquid from running over the surface of the holder, thus destroying the circular contact. No trouble will be experienced in this respect unless too much liquid remains on the stick, or its point is allowed to slip over the surface of the holder.

Fig. 3 shows the apparatus used in taking the accompanying photographs. It consists of a camera *A*, whose lens has been replaced by a wooden frame supporting the holder *B*, so arranged that the holder may be easily removed for replacing the liquid lens. The camera is supported on an upright *C*, fastened to the box *D*. Within the box *D* is a lamp *E* and the camera lens *F* so placed as to concentrate the light on the liquid lens in *B*. The adjustable platform for bringing the slide *H* into focus consists of the board *G* pivoted at one end and supported by the screw *S*. Focusing is accomplished by turning the screw *S*, which should be capable of a vertical adjustment of at least ½ inch, and should make it possible to bring the slide *H* nearly into contact with the liquid lens. The box *D* and the platform *G* have holes in them directly under the liquid lens to let through the light from the lamp.

The image of the specimen is projected by the liquid lens against the ground glass of the camera and sharply focused by turning the screw *S*. When this has been done, the camera is loaded in the usual way. An exposure of 5 minutes with an ordinary kerosene lamp burning half height will probably suffice.

In photographic work, instead of water, it is best to use a glycerin lens, as a glycerin lens will not change its focal length by evaporation, and is not easily shaken by small jars.

For use as a microscope, the apparatus shown in Fig. 4 is sufficient. *M* is a mirror, *L* is the lens holder, *P* is the adjustable platform for holding the slide, and is made like *G* in Fig. 3. The mirror is tilted so as to reflect the light from any source up through the slide. If much field is desired, the eye must be placed quite near the liquid lens.

With this simple apparatus the hairs on the edge of a fly's wing, the teeth on the edge of a blade of grass, wood cells, etc., are distinctly visible; in fact, this simply constructed liquid lens microscope is sufficiently powerful for the needs of most amateur naturalists.

Commissioner Ewing and the Patent Office Building

IN a statement before the Committee on Public Buildings and Grounds of the House of Representatives, Commissioner Ewing has many interesting things to say about the Patent Office building. In the first place, he points out that the Secretary of the Interior occupies about three fourths of the room in the basement and about one half of the rooms on the main floor, and suggests that if the Secretary of the Interior were removed out of the

Patent Office building there would then be not more than room enough to provide for transferring from each examining division the men and women who ought not to be there as a mere question of sanitation, or in the language of the Commissioner, "If we had the whole building it would not be adequate to our purposes, for the building is not large enough as it stands." He refers to the storage necessary for bundles of each of the one million one hundred thousand patents already granted, making a total of forty-seven million copies of patents. The income last year from the sale of copies of patents being $115,000 with a cost of handling the patents of from $15,000 to $20,000, leaving an income of about $95,000 a year net from the sale of patent copies. The 47,000,000 copies of patents being scattered over the building from garret to cellar, so that were a fire to get started, they would unquestionably be destroyed. In urging a new building the Commissioner says: "I want to say that I do not intend to insist that we have got to have a new building in order to do the work better than we are doing it, because we are going to do the work better than we have been doing it, but, as a matter of fact, the crude conditions are extremely bad for the efficiency of the work." Referring to the surplus earned by the Patent Office, the Commissioner pointed out that the Patent Office received last year $137,000 more than it spent, and expressed the belief that this year it would receive more than $200,000 above what it spent, and suggests that while it is proper that the business of the inventors should be paid for by them, it is equally proper that what they do spend should be paid out in giving them a proper return, and that it is to the public's benefit as well as to that of the inventor that the work should be done as well as it can be done. In answer to a question by Congressman Bell of the Committee the Commissioner said that he did not feel that the public were receiving what they should in the way of accommodation and otherwise for the money they are paying, and that they are not only not receiving prompt service, but they are not receiving complete service or efficient service.

First Magnitude Stars

(Concluded from page 280.)

suns. All these then are blazing orbs, of which the faintest, substituted for our sun, would flood us with twice its light, and the brightest with 10,000 times the same.

While the sizes of the fixed stars cannot be measured because of their distances, some estimate of the same may be justified by the light which they possess, even while making due allowance for possible variations of surface brilliancy. In general we cannot but regard the first magnitude stars, as compared not only with earth, but even with the sun, as being giant worlds of the first order. Arcturus alone has been thought to have a diameter 100 times that of our sun, which in turn is 108 times that of the earth.

In the matter of distance, most of these stars are within that degree of proximity which enables them to yield a parallax, by reason of the earth's shift of position, from one side of its orbit to the opposite, every six months. There are only about 300 such stars known. Larger and brighter stars there probably are, so distant that they are dimmed by the enormous gap which separates them from us and leaves us ignorant as to how remote they really are. The nearest of all the stars, so far as measured, is the third of the first magnitude, namely, Alpha Centauri, which requires 4.3 years to send us its light, while our own sun's comes in 499 seconds, or about 8½ minutes. Sirius is twice this distance, and is the third nearest star to earth, to which its extraordinary brilliancy is to be referred, rather than to its size or inherent splendor, great as these doubtless are. Four of these are numbered among the twelve nearest stars to earth, namely, Alpha Centauri (first nearest), Sirius (third), Procyon (sixth), and Altair (twelfth), the latter requiring only 14 years to send us its light.

As we follow through the list, more and

more remote in space do we find ourselves, with 50 light-years for Capella, 99 for Regulus, 112 for Antares, then a strange and enormous gap to nearly or more than 500 for several others, including the magnificent Canopus. It seems strange that the twentieth star is much nearer than the second. What these distances mean is made clearer when we learn that, to travel to the nearest of all the stars, namely, Alpha Centauri, at the rate of 60 miles an hour, would require 49 million years, with an extra 100,000 years disregarded.

As for the location of these brilliant stars in the heavens, the reader is referred to the star atlases. Of the 15 seen by us northerners, 9 are visible in spring, 6 in summer, 6 in autumn, and 9 in winter. Only Rigel and Betelgeuse are found by northerners in the same constellation, namely, Orion, to whose extraordinary brilliancy they contribute not a little. The others are single gems in the constellations which they adorn.

It should be added that eight of these first magnitude stars have companions, whose brilliancy alone runs from 1/2,000 that of our sun in the case of Procyon's companion, and 20 times that of the sun in the case of Rigel's, to 200 times the same in the case of Beta Centauri's, which latter star alone has a brilliancy of 350, making its total brightness 550 times that of the sun. No other first magnitude star boasts of a companion with a brightness of more than one tenth of that of the companion of Beta Centauri.

TABLE OF FIRST MAGNITUDE STARS.

PREPARED BY FREDERIC CAMPBELL, Sc.D.

No.	Name.	Mag.	Light Received.	Distance in Light Years.	Brilliancy times Sun.	Approach (−) Recession (+) Miles per Sec.
1	Sirius	−1.6	100	8.7	48	−5
2	Canopus*	−0.9	52	466	10,000 +	+12.4
3	Alpha Centauri*	0.1	21	4.3	2	−13.7
4	Vega	0.1	21	34.7	160	−9.3
5	Capella	0.2	19	49.4	300	+18.6
6	Arcturus	0.2	19	43.5	230	−3.1
7	Rigel	0.3	18	466	4,000 +	0
8	Procyon	0.5	15	10.1	10	−2.5
9	Achernar*	0.6	13	64	350	.....
10	Altair	0.9	10	13.7	12	−20.5
11	Betelgeuse	0.9	10	109	1,400	−17.5
12	Beta Centauri*	0.9	10	88.1	277	.....
13	Alpha Crucis*	1.1	8	59.3	207	.....
14	Aldebaran	1.1	8	44.7	110	+34.2
15	Spica	1.2	8	500 +	2,000 +	+1.2
16	Pollux	1.2	8	50.9	125	+1.9
17	Antares	1.2	8	112	630	−1.9
18	Fomalhaut	1.3	7	23.6	25	.....
19	Deneb	1.3	7	500 +	1,800 +	−36
20	Regulus	1.3	7	99	420	+23

* Southern stars.

The Electrolysis of an Egg

By Albert A. Somerville

SUPPOSE the ends of an egg are punctured, so as to admit small wires, and that by means of these two lead wires the egg is made a part of an electrical circuit, all of which is easily done. Now the electrical resistance of the egg may be measured in ohms, *probably*. Then if the terminals are connected to a power circuit, current may be sent through the egg and thereby generate sufficient heat to cook it, *possibly*. Now that egg is neither fried, boiled, poached nor scrambled. If it is cooked at all, will someone be so kind as to suggest a name for it to put on a bill-of-fare in some Broadway café? Someone has suggested that it might be known as an electrocuted egg. This would probably apply better if there were a chicken inside.

The body of an egg consists primarily of a great mass of albumen. When the contents are decomposed by time or by an electric current there is formed a large volume of gases, principally nitrogen, hydrogen, and oxygen.

The shell consists mostly of carbonate of lime, and may be so nearly colorless or translucent that the contents of a fresh egg show a pinkish blush through it.

The idea of the investigation was to cook the egg by sending current through it, its own resistance causing the requisite heat to be generated upon passage of the current.

It is well known that the amount of heat generated per unit of time in an electrical circuit is proportional to the current flowing multiplied by the electromotive force, or stated another way, is proportional to the product of the current squared and the resistance. Also it is known that great progress is being made along the line of electrical heating for scientific, commercial and domestic purposes. Even though the efficiency is fairly high the expense of electrical heating is considerable, and as yet the only thing to recommend it is its cleanliness and convenience. For scientific and commercial work, where very high temperatures are desired, arc furnaces are used principally. In domestic use, where only moderate temperatures are required, the resistance type of heater is used, the resistance unit formerly being wound with some pure wire, and more recently with some alloy having smaller coefficients of variation with temperature change. That is, if the length of the wire is nearly constant at all temperatures it is easier to insulate and hold it in place, and if the resistance is nearly constant the variation in current is easier to control.

If a heater is to be made, the resistance is adjusted so that if connected to a certain common voltage a certain temperature will be attained in a specified time. All the heat generated or nearly all has gone into the heater, but even from there not more than half of it gets to the desired point where the heat is to be applied in the case of most heating appliances, and it is only in a few cases that the heating unit can be located within the thing to be heated so as to utilize practically all of the heat to advantage.

If the thing to be heated could itself be made the conductor to carry the current and to offer suitable resistance to the same, then all the heat would be generated within the body to be heated and the efficiency would approach 100 per cent as soon as possible.

A 16 candle-power incandescent carbon lamp measures about 220 ohms and draws ½ ampere on a 110-volt line. If placed in a vessel containing water it will bring a pint of water to the boiling point in a very reasonable time. Instead, however, of using the lamp as a heater two terminals may dip into the water when properly prepared and the resistance of the water itself may be used as the heating unit instead of a wire coil. The resistance of the human body is said to be anything from 5,000 to 15,000 ohms, so that of a slice of meat ought to be something within the hundreds, and if placed between two metallic plates or conductors connected to a line or proper voltage, such a slice of meat should be cooked by means of the current by virtue of its own resistance.

The electrical resistance of a loaf of baker's bread taken from end to end is about 2,000 ohms, so the resistance crosswise of a slice of the same is about 100 to 200 ohms, as readily measured by a Wheatstone bridge method. If a slice were placed between the two metallic plates connected to proper voltage it should be nicely toasted, and then since toasted bread is an insulator, it should automatically cut off current when it is thoroughly toasted or done.

In all these cases all the heat is generated in the thing itself which is to be heated, so very little heat is lost. The method was actually tried upon an egg in the manner indicated in the opening paragraph. Three distinct steps were made in the experiment. It was necessary to know

whether or not the contents of an egg would carry a current or whether it was a high insulator, or if not, what its electrical resistance would measure. For this first part, small holes were pricked in the opposite ends of a fresh hen's egg, small copper wires inserted through these holes to a depth of a quarter of an inch or more, and these wires connected to the Wheatstone bridge. The resistance of the egg would then be measured just like any other unknown resistance. When the circuit was first closed and the bridge balanced a resistance of about 1,000 ohms was indicated, but this resistance slowly and steadily increased for several minutes until its former value was more than doubled. If the circuit was broken for a few minutes and then closed again, the original resistance was regained and the same change was executed as before. This could be repeated many times. Only one or two volts of electromotive force was being used, and it was thought that this change in resistance was due to some change taking place at the terminals, which would be overcome by using a higher voltage.

The terminals were accordingly connected onto a 110-volt direct current supply, with an ammeter and voltmeter in circuit so as to measure the resistance by means of the relations $C = \frac{V}{R}$ or by what is known as the "potential drop" method.

When the circuit was first completed the ammeter registered about one tenth of an ampère, thus indicating the proper resistance of approximately 1,000 ohms. Shortly, however, the current began to decrease, indicating an increase in resistance, the potential drop remaining constant, and this increase in resistance went on much faster than when only one or two volts were used in the Wheatstone bridge method.

The current decreased until almost inappreciable. The holes in the ends of the egg where the lead wires were introduced had automatically sealed themselves on standing several hours, so that the egg might ordinarily have been considered intact or air-tight. You have heard of people sweating blood. This egg began to sweat albumen. Literally the white of the egg was being forced out through the pores of the shell. Practically everything is porous. Water can be forced through the walls of an iron vessel if sufficient pressure is brought to bear upon it. An egg shell is porous. That is the reason for coating eggs with paraffine to prevent air leaking in and so allowing the egg to decay. It is by means of these same pores that the chick receives its oxygen to breathe. Since the white was being forced out through the pores in the shell some pressure must have been brought to bear on the inside. This might be due to heating, but the current was so small by this time that there was no appreciable heating.

Another idea would be that the formation of gas, due to the decomposition of water into hydrogen and oxygen, was the cause of the pressure. One would at first think that these gases would have been forced out through the pores of the shell rather than the white of the egg, but probably both gases and white went out together, the gas carrying small particles of the white with it. Finally after about an hour nearly all the white of the egg was forced on the outside, the 110 volts having been on all this time, the current being measurable only in hundredths of an ampère. Suddenly there was a spark and an explosion—it seems that the hydrogen and oxygen had been separated by the current and the gases formed, after forcing most of the white of the egg out of the shell, had then circulated around until the resistance broke down at some point, allowing a spark to pass, and so set off the gases which were present in the right proportion to produce a good explosive mixture. Anyone who has ever seen a mixture of hydrogen and oxygen exploded in a glass flask may have just a slight idea of what happened when the gases in that egg shell exploded. Only a deep-sea diver's suit could have protected a man from the spattering.

SELENIUM AND ITS REMARKABLE PROPERTIES are fully described in Scientific American Supplement 1430. The paper is illustrated by numerous engravings. Price 10 cents. For sale by Munn & Co., Inc., and all newsdealers.

It was then decided to use an alternating instead of direct current in the hopes that this decomposition would not occur. Also, it was possible to obtain higher voltages from the alternating current supply. It was accordingly tried with these results. Voltage was varied from 175 to 238 and 575 volts, successively. The current remained at 0.1 ampère for some time, and finally gradually decreased at the higher voltage to about 0.01 ampère. Evidently the egg became to some extent a rectifier. At one terminal only there occurred continuously a series of very small explosions which could be distinguished from the ordinary sparking, which sparking made the egg beautifully translucent throughout. It was also accompanied by a very distasteful odor not unlike that of decayed eggs or burning horn. Since there was no cooking whatever it was thought best to call the experiment that of "The Electrolysis of an Egg."

Motion Pictures of Vocal Chords

By Jacques Boyer

ALL vocal sounds originate in the larynx, where the breath is forced through a slit formed by two membranous cartilages, which are popularly known as the vocal chords. These cartilages approach and recede from each other, thus varying the width of the slit, and they are thrown by the outrushing air into vibrations of greater or less rapidity, which are communicated to the air current which has excited them. The buccal cavity, comprised between the glottis and palate and the lips, acts as a resonator, reinforcing certain harmonic components of the original complex vibration and giving the sound its particular vowel quality, while the consonants are produced by movements of the tongue and lips. In other words, the voice results from a laryngian vibration modified by the cavity of the mouth and other supra-laryngeal resonators.

The exceedingly rapid aerial vibrations which constitute spoken words—from 80 to 1,000 vibrations per second—were photographed by Dr. Marage, years ago, and now Mlle. Chevroton and Mons. F. Vlès, with the collaboration of Mme. Marage, have obtained motion pictures of the movements of the vocal chords. These experiments are so delicate and so irksome to the subject that they had scarcely been attempted before with human subjects. Czermak, Stein, French, Wagner, Brown, Blucke, Cadett and others had endeavored to photograph the glottis in fixed positions, but had obtained only mediocre results. Garel alone had succeeded in producing good stereograms of the vocal chords.

Mlle. Chevroton and Mons. Vlès solved the problem by placing in front of the camera two isosceles right angled prisms connected by their hypotenuses. The rays of an electric arc, made parallel by a lens, are reflected along the axis of the camera to the throat of the subject by one prism, and the rays emitted by the glottis, thus illuminated, pass along the same axis through both prisms to the camera. This invariable relation between the illuminating and the effective rays facilitates the management of the laryngoscope, the position of which relative to the photographic field can easily be rectified by means of a total reflection prism placed behind the film.

From a study of the cinematograph films thus produced it appears that most parts of the larynx contract in passing from respiration to voice production. In general, the maximum width of the vocal chords coincides with their maximum apparent length, and their phases of repose and of widest separation, during inspiration. The sharpest photographs are obtained at these epochs. The measurements of the length of the vocal chords possess less interest, as the part played by each element in the change of length is not known, and the shortening of the chords is marked by the movements of the epiglottis and cricoid and by a general contraction of the uppert part of the larynx.

On the other hand, the minimum width of the vocal chords coincides with their minimum apparent length and their phases of sound emission and closest approxima-

¶ *The* CONSTRUCTION *of an* INDEPENDENT INTERRUPTER

Clear diagrams giving actual dimensions are published. Supplement No. 1615 gives a clear and concise description on the construction of an independent Interrupter. Order from your newsdealer or from *Munn & Co., Inc., 361 Broadway, N. Y.*

tion. At these instants the photographs are least sharp, because of the rapid vibrations of the chords. According to the experiments of Prof. Franck of the Collège de France, the limits of physiological variation in width of the vocal chords of a soprano are 3.2 millimeters (0.126 inch) and 1.4 millimeters (0.055 inch).

In the transition from inspiration to phonation or, more generally, during any sudden and profound change of position, the vocal chords appear to be the seat of vibrations of great amplitude and brief duration which produce multiple images of the source of light in the little mirror of the laryngoscope. This phenomenon, which affected only one of the chords and continued only from 0.1 to 0.8 second, was probably caused by a lack of synchronism in the movements of the various muscles involved in the change of position, the still lax chords being violently shaken either directly by the muscles or indirectly by variations of air pressure produced by their movements.

This novel application of cinematography will doubtless throw light on more than one hitherto obscure point in the physiology and pathology of the larynx.

How Scientists Are Studying the Aeroplane

(Concluded from page 285.)

stallation. This transportable testing plant mainly consists of a light carriage traveling on rails, which is driven by the propeller itself, actuated in its turn by a 60 horsepower automobile motor. All measurements are recorded automatically. The propeller shaft arranged about 3.5 meters above the track is so combined with a parallelogram that the whole system is free to move in the direction of the thrust, transmitted by an angle lever to a cylinder, the pressure of which is transferred hydraulically to a recording manometer. Moreover, the upper casing is free to pendulate round the propeller shaft, so that the reaction of the torque also tends to produce a deflection, transmitted to the same recording manometer.

A special branch of meteorological work, *aerology*, has been formed of late years, mainly with a view of investigating the higher strata of the atmosphere, which are important for aerial navigation.

The Royal Aeronautical Observatory conducted by Prof. Assmann is situated at Lindenberg on a hill dominating the surroundings, at 65 kilometers to the southeast of Berlin. It comprises in addition to the laboratory-rooms, a small balloon hangar and a rotatable capstan house erected on the top of the hill, whence kite and balloon ascents are made; further an electrical power house which also manufactures the necessary hydrogen, by means of a Schmidt electrolyzer. Apart from kites and captive balloons carrying recording apparatus, there are launched pilot balloons, the course of which is followed by means of special theodolites from trigonometrical stations situated 3 kilometers apart and connected together by telephone. The wind conditions in the free atmosphere are gaged daily at 15 places in Germany by pilot balloons, and are communicated to Lindenberg, in order to be thence transmitted on in the form of collective telegrams. Special gale and thunder storm observations, according to a scheme organized by Assmann, are telegraphed immediately to Lindenberg from about 500 places, situated in North Germany, thus allowing the arrival of a gale or thunder storm, at a given place to be predetermined.

The aerological departments of other German meteorological observatories are arranged in a similar manner. The Teneriffe Observatory, which has been organized by Prof. Hergesell, mainly serves for observations of the higher atmospheric strata above the sea by means of twin balloons.

A propeller testing plant has been recently installed by the Siemens-Schuckert-Werke at Berlin-Nonnendamm on a high speed test electric locomotive traveling on a circular track 270 meters in diameter.

Interesting experiments have also been made by Prof. Donat Banki with a Blériot monoplane fixed by its front wheels on the roof of a rail-motor car, thus allowing its stability to be tested at speeds of 60 kilometers and more.

NEW BOOKS, ETC.

WORK, WAGES AND PROFITS. By H. L. Gantt. New York: The Engineering Magazine Company, 1913. 8vo.; 312 pp.

The addition of more than a hundred pages to the first edition of this work has given Mr. Gantt the opportunity of correcting the impression that his methods are summed up in the bonus system. This is but one feature of the plan so successfully initiated by the author, and preceding this feature and forming the very foundations upon which the system rests are microscopic investigation, thorough standardization, personal instruction, and interconnected reward both to the supervisor and the workman. The illustrations used are drawn mainly from the textile industry. The results secured by the system in this industry are little short of phenomenal, as is graphically shown by the series of colored charts that form inserts to the volume. We see, for example, the time-sheet of a weave room. The workman is required to reach a certain standard of efficiency before he is entitled to a bonus; the days in which he fails to earn this bonus are blocked in with red; those on which a bonus is earned are blocked in with black. Steady improvement is noted as our eye crosses the page, until at the end of a few months red has almost entirely given place to black—inefficiency to efficiency, low earnings to high. Such actual records of achievement are attractive to the verge of conviction. Certainly they bespeak for such systems a fair trial.

INDUSTRIAL CHEMISTRY FOR ENGINEERING STUDENTS. By Henry K. Benson, Ph.D. New York: The Macmillan Company, 1913. 8vo.; 431 pp.; illustrated.

The student having some knowledge of elementary physics and general chemistry will find in this text a useful guide dealing with the materials, processes and apparatus commonly used in the engineering professions. The lessons take up such subjects as the atmosphere, industrial water, combustion, distillation, fuels and lubricating oils. Various products of manufacture are also described—pig iron, commercial iron and steel and their alloys, clay, cement and lime products, paving, and paint materials. Cellulose products and explosives also have their chapters. In short, the prospective engineer who follows the text with care and thoroughness will find himself possessed of a working knowledge of the chemistry of materials and processes, and an ability in the pursuit of experimental research that will go far toward solving his problems.

SUCCESS WITH HENS. By Robert Joos. Chicago: Forbes & Co., 1914. 12mo.; 234 pp. Price, $1 net.

THE BACK YARD FARMER. By J. Willard Bolte. Chicago: Forbes & Co., 1914. 12mo.; 238 pp. Price, $1 net.

Regarded as a crop, the product of our "billion-dollar industry" is in value second only to corn, and exceeds that of oats and wheat combined. "Success with Hens" exudes common sense, and avoids the impossible estimates and extravagant promises that too often mar books of this kind. It instructs the tyro in the various subtleties of the occupation, details methods of equipment, hatching, brooding and feeding, considers both intensive and extensive systems of farming, and meets with practical advice the drawbacks and exigencies encountered in the business. "The Back Yard Farmer" also devotes nearly half its space to poultry; the remainder discusses plans for making the back yard pay dividends by way of the fruit and vegetable garden. Hedges, shrubs, fruit trees, vines and the general beautification of the lawn and the surroundings come in for consideration, and there are hints on the keeping of bees and the care of the horse and the cow. This manual also maintains a conservative tone, and its instructions are based on sound principles.

LABORATORY MANUAL OF GLASS-BLOWING. By Francis C. Frary, Ph.D. New York: McGraw-Hill Book Company, Inc., 1914. 16mo.; 60 pp.; illustrated. Price, 75 cents net.

The elements and processes of glass-blowing are presented with the aim of enabling the laboratory man to modify or repair his own apparatus. In some situations this may mean the saving of considerable time and money. The author assumes that the reader is entirely ignorant of the art, hence his explanations are lucid and adequate.

A MANUAL OF BACTERIOLOGY. For Agricultural and General Science Students. By Howard S. Reed, Ph.D. New York: Ginn & Co., 1914. 8vo.; 179 pp.; illustrated. Price, $1.25.

Students will find, in this manual, experiments whose precise results will banish doubtful habits of thought and the consequent vagueness of understanding. An added section of the work takes up fermentations caused principally by fungi. There is a large section of appendices, dealing with such subjects as sterilization, and containing tables of determinations, conversion tables, and record forms.

BOY'S BOOK ON LOGIC. A Talk, Not a Treatise. By William Timothy Call. Brooklyn, N. Y.: W. T. Call, 1914. 16mo.; 96 pp. Price, 50 cents.

We are inclined to think Mr. Call's pabulum a trifle too cynically flavored for youthful consumption; there is too much of the strong man's meat along with the milk for babes; but the tiny volume is marked by the author's usual aptitude for getting down to fundamentals and expressing certain forms of truth in a humorous and alluring way. We are initiated into the mysteries of faro; we meet Fido, of the thin hind legs; incidentally and unconsciously we absorb a few principles of logic. Every boy will be in hearty accord with Mr. Call in his desire to simplify grammar—to "strip it to the buff," as he terms it. There is no law confining the perusal of the book to boys, and those of a larger growth may enjoy and profit by it.

THE CLIMATE AND WEATHER OF AUSTRALIA. By H. A. Hunt, Griffith Taylor, B.A., B.Sc., and E. T. Quayle, B.A. Melbourne: By Authority Albert J. Mullett, Government Printer, 1913. 8vo.; 93 pp.; illustrated. Price, 5s.

This, the first published text-book on Australian meteorology, is issued under the authority of the Minister of State for Home Affairs. Under "Climate" it treats of the effect of the size of the continent on climatic variation, of the march of temperature, the barometric variation, the distribution of dominant winds, special factors of climatic influence, and the chief climatic regions. Under "Weather" are discussed the characteristics of drought years, local rains, hurricanes and "bursters." Methods of forecasting are sketched, and the monograph is enriched by numerous maps of mean temperatures, heat waves, pressures, humidities, and rainfalls; by graphs of the mean monthly rainfall and of maximum and minimum temperatures for the various stations; and by charts of noteworthy hurricanes.

THE SOUTH AMERICA TOUR. By Annie S. Peck, M.A. New York: George H. Doran Company, 1913. 8vo.; 398 pp.; illustrated. Price, $2.50 net.

The questions "What is there to see?" and "May the journey be taken in comfort?" are answered with a wealth of detail in the pages of Miss Peck's rather bulky volume. She unfolds before us some of the finest scenery in the world—mountains that shame the Alps, cliffs overtopping those of the Yosemite, far-flung gardens of Allah, waterfalls among the highest and the most beautiful in the world. The intermingling of strange peoples, the fascinating mosaic of ancient and modern, ruins and antiquities on the one hand and railroads and splendid city buildings on the other, call to us from the happy descriptions of the author's pen and the clear reproductions of her camera. These assure us of comfort on the way, and tempt us, if not to the actual undertaking of the journey, at least to the continuance of the personally-conducted tour by which she leads us through the pages of her attractive volume.

THE HOME NURSE. By E. B. Lowry, M.D. Chicago: Forbes & Co., 1914. 12mo.; 224 pp. Price, $1 net.

The importance of good nursing in illness can scarcely be over-estimated. There are thousands of homes where a trained nurse cannot be employed, and where the duties of nurse devolve upon a member of the family. Willing as she may be, her efforts are too often ill directed, and the physician's orders are but indifferently carried out. Dr. Lowry's book publishes the principles of general nursing—the care of the sick-room and the patient, the observation of symptoms, and the administration of medicine; it gives instructions for nursing in special diseases—typhoid, pneumonia, etc.; and cites simple remedies and modes of relief for those minor disorders and accidents which occur in every home.

THE MECHANICAL ENGINEER'S REFERENCE BOOK. A Handbook of Tables, Formulas and Methods for Engineers, Students and Draughtsmen. By Henry Harrison Suplee, B.Sc., M.E. Philadelphia: J. B. Lippincott Company, 1913. 16mo.; 964 pp.; illustrated.

In any compilation of tables, methods and formulas, the merit of the resulting volume largely depends upon the selective judgment of the compiler. With such a vast field as that of engineering, the task calls for exceptional knowledge, close valuations, and alert faculties, even though the material be limited to the mechanical section of that field. This reference book has stood the test of time, and having been recently revised and enlarged, now passes also the test of timeliness. Machine design is very fully dealt with, and the men of the draughting room will find in the book both general principles and detailed methods. Only the more widely applicable rules and formulas are furnished. Thus not the user's shoulders, but the author's, bear the burden of selection.

VILLAGE IMPROVEMENT. By Parris Thaxter Farwell. New York: Sturgis & Walton Company, 1913. 16mo.; 362 pp.; illustrated.

"Village Improvement" is a well-planned and informing little book dealing with all phases of town-beautification. Addressed particularly to those not having ready access to libraries and hence somewhat out of touch with the progress that is being made, it teaches how, with little expense and small trouble, one may surround his home and his farm with the improvements that mean so much in convenience and in solid satisfaction. The work presents village improvement in its general aspects, and from that proceeds to specific and practical suggestions in regard to roads, greens, fountains, shrubbery, bridges and buildings. A form of constitution adapted to improvement clubs is given, and proved methods of operation are recounted very fully. Pictures of what has thus been accomplished the country over brighten the pages and add to their inspirational value.

THE NEW PHILOSOPHY. Science of Physical Phenomena. By Calvin Samuel Page. First Explanations of Electricity, Gravitation, Repulsion, and the New Atomic Element Rex. Chicago: The Science Publishing Company, 1913.

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12961) E. H. asks: 1. Would a 10-pound weight of iron sink to the bottom of the deepest part of the ocean, if thrown into it, or would it float at a certain depth? A. An iron weight, or chain, would sink to the bottom in the deepest part of the ocean. Iron is 7.7 times as heavy as water, and must sink in water. The water at the bottom of the ocean is but 1-20 heavier than at the surface, since water is practically incompressible. Hence there is no point at which the iron can stop and float. Mere pressure does not prevent sinking. The air presses upon us tremendously, but we fall readily through it, because the pressure is equal in all directions. The same is the case with sinking in the water. 2. If it did sink, would it gain velocity as it went deeper? A. Calculation based upon theory shows that an iron weight will gain velocity as it falls in water until a depth of about 2 miles is reached, after which the velocity will become uniform, and will be 321 feet per second. The solution is to be found in Thomas Webster's "Theory of the Equilibrium and Motion of Fluids," London, 1836. The quantities given above are for solid spheres, and not for other shapes. 3. Is there any part of the Atlantic Ocean that is too deep to sound? A. There is no place known, in any ocean, which has not been sounded. The greatest depth is over 6 miles. It is in the Pacific Ocean.

(12962) B. S. asks: Please be so kind as to tell me in the Notes and Queries, what are the electrolyte and electrodes of the Nodon valve and what is the efficiency of that apparatus in rectifying the 110-volt alternating current? A. For a Nodon valve aluminium and lead plates are ordinarily employed, and ammonium phosphate for the solution. Full instructions may be found for the construction in our SUPPLEMENT 1679. Another good article on this subject is to be found in SUPPLEMENT 1644, and another form of electrolytic rectifier is described in the SCIENTIFIC AMERICAN, vol. 109, No. 13. We send the three copies for 30 cents.

(12963) B. F. C. asks: 1. In discussing latent heat as connected with making ice cream, is it proper to say that salt has an affinity for heat? Does salt have an affinity for ice or water, and what is the chemical reason why ice melts when in contact with salt? A. There is no chemical action involved in the melting of salt and ice. It is a simple physical fact that salt and ice melt when brought into contact with each other. So, too, do many other substances. Melting is always accompanied by the loss of heat—the heat necessary to melt the substances. The freezing point of the solution is lower than that of either the salt or the ice. It is 7.6 deg. Fahr. below zero and 39.6 deg. Fahr. below the freezing point of water. The freezing point of a solution is always lower than that of the solvent. So salt dissolved in water lowers the freezing point of the water. 2. What amount of rainfall would be equivalent to one foot of average snow? A. The U. S. Weather Bureau allows one inch of water for each ten inches of snow as a fair average of dry and wet snow.

(12964) J. T. E. asks: I would be glad to be informed through your paper as to the following: Is there a known solid which has an electrical resistance in proportion to the pressure upon it, either by compression of the solid itself or of the contacts? A. Carbon is the material for a rheostat which meets the condition which you impose, that its resistance shall vary with the pressure. Plates of gas carbon are placed in a retaining box and a screw brings them into closer contact, thus increasing the current which flows through the box The plates stand upon edge, so that their weight does not add to the pressure at the bottom, as would be the case if they were laid flat piled up upon each other. They are rated to carry about 125 amperes per square inch. You can obtain such rheostats from any dealer in electrical apparatus.

(12965) G. R. L. asks: In the discharge of lightning, does all of the current pass from cloud to earth, or is the current an oscillating one? A. The discharge of the electric stress between a cloud and the earth takes place in either direction or both directions at once. An old professor of physics used to say that he had trained himself to see the flash go either way as he chose. The duration of a flash is so very brief that the eye cannot take cognizance of its direction, and it may well be that one can see it go up or down as his mental association suggests. The flash may also oscillate and pass many times up and down before it dies out. In such a case it may be photographed as banded lightning by rotating the camera during the discharge. You will find a valuable article on this subject, with illustrations, in our SUPPLEMENT 1635, price ten cents.

(12966) M. T. asks: Two vessels identical in every respect concerning weight, size, volume and shape are placed on a pair of scales. One of them contains hydrogen at the ordinary atmospheric pressure, while the other vessel is a complete vacuum. The weighing operation is done in air. Now which of these two vessels would weigh more—the one containing hydrogen or the other? A. A vessel which contains hydrogen will weigh more than one in which is a vacuum and which therefore contains nothing, whether weighed in the air or in a vacuum Hydrogen at atmospheric pressure and at the freezing point weighs 0.00562 pound per cubic foot, and that quantity is the amount which the vessel containing the hydrogen would weigh more than the other for each cubic foot of its contents.

(12967) E. McM. asks: Is there any method of sterilizing cloth that can be used at home? One that does not ruin the material. A. The simplest way to disinfect cloth is by the use of heat. Cloth may be heated to 250 deg. Fahr. without injury, so that clothes, bedding and cloth generally can be disinfected in this way with entire safety. Another method is by exposing the cloth to the action of the vapor of formaldehyde. Formalin heated in a basin will give off the vapor abundantly, and any cloth which is permeated by this vapor will be disinfected. It does not affect the color of the cloth.

(12968) R. M. S. asks: Cannot the gyroscope be applied either directly or indirectly to the guiding and control of an equatorial telescope, in place of clockwork? A. We are not prepared to pass upon the possibility of controlling an equatorial telescope by a gyroscope. It is a question of the perfection of a mechanical appliance. A gyroscope might be made to run as uniformly as the best clock movement, in which case it could be applied to a telescope.

(12969) E. S. M. writes: In your answer to F. D. D., Query 12943, in the current issue of your very valuable paper, you do not set the gentleman right in one particular; and, as this matter proved a source of annoyance to me, I venture to suggest that you refer him to page 200 of the Nautical Almanack, where nearly the identical problem is stated thus:

January 21st, Sid. Time at G. M. Noon	20	00	01:35
Red. (None in this case)	..	..	.....
Add local Ast. mean time	18	17	20
Sid. time (less 24 hours)	14	17	21:35

His mistake is in overlooking the fact that the Siderial Time at his place is the sum of the Siderial Time at that instant (corrected) plus his local Ast. Mean Time for that instant. His clock face should show the Right Ascension of his meridian, not that of Greenwich. The figures above are taken from his data to make it a little plainer.

(12970) R. B. asks: Can you explain why these odd weights and dimensions were adopted for the unit of electrical resistance—the ohm? 14.4521 grammes mercury at 0 degrees, when in the form of a uniform cylinder 106.3 centimeters, having a section, therefore, of practically 1 square millimeter. Why not 15 grammes Hg at 22 deg. Cent., 100 centimeters long, 1 square millimeter in section? It is noticed in a good many standard units, that odd figures are given. For instance, the ampere, defined as electricity depositing 0.001118 gramme of silver per second. Why not 0.001 gramme? A. Perhaps the simplest presentation of the subject of the derivation of the electrical units to which we can refer you is in Silvanus P. Thompson's "Elementary Lessons in Electricity and Magnetism," price $1.55 postpaid, found under the heading "Units" in the index. The electrical units were determined and adopted by an International Congress of Electricians, which met in Chicago in 1893, composed of delegates from the nations of the world, officially commissioned by their governments to act in this capacity. The several units are derived from the absolute or centimeter-gramme-second unit of force, the dyne. Thus, a current has unit strength when its circuit bent into an arc of one centimeter radius exerts a force of one dyne upon a unit magnet pole placed at the center of the arc. There exists a unit of difference of potential between two points when one erg of work is done in bringing one unit of positive electricity from one point to the other against an equal and similar electric force. And there exists one unit of resistance in a conductor when one unit of difference of potential will cause one unit of current strength to flow through the wire. So, too, for all the other units of the system. Some of these absolute units are too large, and others are too small for practical use. For this reason other units, called practical units, are employed, which have definite relations to the absolute units. The ampere is one of these and is one tenth of the absolute unit of current strength. It will deposit the weight of silver which you name. This weight has been determined with minutest care. So, too, the ohm is 10^9 absolute units of resistance, and it was determined with the highest accuracy. The length of the mercury column was not guessed at, but is the exact quantity required, and it will have just the weight you give. Considering the enormous sums of money which are invested in electrical enterprises, the importance of the accurate measurement of electrical quantities is evident. Considering that America is exporting hundreds of millions of dollars worth of electrical apparatus every year, the importance of an international agreement, upon what shall constitute the value of the units in which its work shall be rated, is also evident. Our machinery should come exactly to the value set by international agreement, not pretty near to it. An ampere of exactly 0.001118 gramme of silver per second, and not 0.001 gramme, is what we ought to give.

Type your bill. Stop! It is footed—total proved

This latest Remington time-saver ends a needless waste of clerical time

From now on bills and statements will be written-out and footed-up simultaneously.

One operation does it.

The typist inserts a bill head in the Remington Adding and Subtracting Typewriter.

She copies the items.

But look!

Every time the numeral keys are pressed, the figures are both typed and *added*. The bill *automatically* foots—with cold steel accuracy.

If the typist prints a wrong total, an error-signal at once calls a halt.

The footings will be as correct as though proved by a certified accountant.

The bill—neatly typed and complete—is mailed without a moment's time spent on addition, subtraction or total-proving.

* * * *

This marks a tremendous advance in billing and accounting.

Hereafter, every moment spent in footing bills will be a sheer waste of clerical time.

This machine does *your* work *your* way.

You can start using it tomorrow—without altering your accounting system in the slightest.

The only change it forces is a change from human inaccuracy to mechanical precision—from time-waste to time-saving.

* * * *

The Remington Adding and Subtracting Typewriter is

(1)—always ready as a complete easy-running typewriter, for letter writing.

(2)—always ready as a quick adder and subtracter, for listing.

(3)—always ready for both writing words and adding figures at one operation.

This latest and most remarkable Remington time-saver is now used constantly in thousands of retail stores, banks and business offices—large and small.

The United States Sub-Treasury and the New York City Finance Department use it continuously.

Machines installed five years ago have paid for themselves over and over again, in time saved—*to say nothing of errors caught before they were made.*

* * * *

The Remington Adding and Subtracting Typewriter puts the old methods of footing bills and statements into a past business age.

A booklet, "The New Remington Idea," gives more details. Write for it today. It is much easier to *keep up* with the times than to *catch up.*

* * * *

The Remington Adding and Subtracting Typewriter can be had in any of the Remington Models shown below.

Each is a member of the famous Remington family.

Each is a complete easy-running typewriter, plus the adding and subtracting feature.

Each is designed and built so as to insure maximum durability.

Each has distinctive features designed to meet individual requirements.

REMINGTON
Adding and Subtracting TYPEWRITER
(WAHL MECHANISM)

Remington Standard — Monarch Model — Smith-Premier Model

Your totals are shown here as fast as the figures are typed

Remington Typewriter Company, Incorporated, New York City (***Branches Everywhere***)

For clear, clean, typewriter results, use Remtico brand letter paper, carbon paper and ribbons.

Ask yourself if your filing cabinets combine all of these necessary characteristics— ***Durability, Safety, Economy, Ease of Operation, Mechanical Perfection***

OMECO
on office furniture stands for

Durability—which means perpetual service.

Safety—which insures your records against impairment or loss.

Economy—which is gained through long life, the saving of time and the conservation of space.

Ease of Operation—which is produced through the installation of the Edwards Roller Suspension—ten steel rollers for each drawer.

Mechanical Perfection—which is made possible by thorough knowledge, careful attention to details of construction, and the use of only the highest grade materials.

OMECO Steel Office Furniture
— IS —
Fire-Proof — Dust-Proof — Vermin-Proof

Add to this beauty of design, superiority of finish, and interlocking sectional adaptability, and you will understand why **OMECO** has been installed in the battleships of the United States Navy, the offices of the American Sugar Refining Co., Borden's Milk Company, Hanover National Bank, the New York Life Insurance Company, and many other prominent business houses.

Buy OMECO and Buy for Life

For complete details, catalog, and expert information bearing on your own filing problems, address

THE O. M. EDWARDS COMPANY, SYRACUSE, NEW YORK

The Remedy—for tire troubles
—for costly puncture-caused delays
—for frequent, expensive inner-tube replacements—

LEE Puncture-Proof Pneumatic TIRES
LEE PATENTS

Not a troublesome outer covering to kill resiliency—not an inner casing to be attached—but an *extra service pneumatic tire* which gives you all that any other tire does, *plus freedom from punctures.* A pneumatic tire that is protecting others from punctures at one-fifth of a cent per mile.

Thousands of motorists call **Lee Puncture-Proof Pneumatics** "the tires that put the *sure* in plea*sure*"—there are 3,200 puncture-proof reasons why. Every reason a specially treated armor-steel disc, imbedded in rubber, in overlapping layers, with heavy fabric between—which makes friction and heating impossible.

Made, like all Lee tires, of the "Vanadium" Rubber
live, extra-dense, doubly tough
TRADE MARK

—the newly discovered Lee product which assures longer life, greater resiliency and comparative freedom from oil-rotting. Considerably over size of average moulded tire.

Furnished with regular tread, or the **Lee "Zig-Zag" Non-Skid,** "Master of Slippery Situations." Sold under an absolute

"Puncture-Proof or Money-Back" Guarantee

which assures you of freedom from punctures, or the return of every extra penny you paid for insurance against them. You can't lose—you have much to gain.

Write now—before you forget it—for a copy of that guarantee, and Illustrated Pamphlet No. 6—with full details on construction and owners' reports of service.

Sold in every leading city. Simply look up "Lee Tires" in your 'phone book.

LEE TIRE & RUBBER COMPANY
CONSHOHOCKEN, PA.

EVINRUDE

The Best of Summer Pleasures —Yours in One Minute

Any rowboat, private or rented, can be turned into an eight-mile-an-hour motor-boat in less than one minute if you own an

Evinrude Detachable Rowboat Motor

It attaches to rowboats of all shapes and sizes, canoes and duck boats; starts with one-twelfth turn of the flywheel and is so simple to operate that women and children may enjoy the pleasures of "Evinruding". Besides its many other attributes the following exclusive features are most noteworthy:

The Only Portable Motor with a Built-In Reversible Magneto

The Evinrude Magneto is built within the flywheel and in that manner is protected from all injury. It has no brushes, bearings or commutators to wear out and is not effected by rain, waves or even complete submersion.

The Only Portable Motor which Does Not Require a Rudder

The propeller turns freely in either direction to steer the boat. There is no rudder to become entangled in the weeds, fouled or damaged by rocks and driftwood. The propeller turns the boat within its own length.

The Only Portable Motor with a Maxim Silencer

We can now supply special Maxim Silencers for 1913 and 1914 "Evinrudes". The Silencer eliminates practically all noises. No similar motor can use the Maxim Silencer as it is an exclusive "Evinrude" feature.

The Only Portable Motor with a Compensating Steering Device

The tiller is controlled by a shock-absorbing, Compensating Device which allows the tiller free range in either direction and permits steering without the exertion or strength, which is necessary with a rudder.

The Roosevelt Expedition, the Stefansson Expedition

and other important parties of explorers are using the "Evinrude", while throughout the entire world those who love the water are enjoying the thrills and pleasures of motor boating with any ordinary rowboat. The "Evinrude" is on sale at Sporting Goods and Hardware Dealers everywhere. Have you seen it?

Evinrude Magneto Motor, 2 H. P. $80.00
Evinrude Battery Motor, 2 H. P. $70.00

Illustrated catalog free upon request

EVINRUDE MOTOR COMPANY, 183 F Street MILWAUKEE, WIS.

BRANCH OFFICES:
San Francisco, 483 Market St. Portland, Ore., 106 Fourth St. Jacksonville, Fla., Foot of Main St. Savannah, Ga., Stiles Ave. and W. Gaston St. New York, 89 Cortlandt St. Boston, 218 State St.

EVINRUDE
DETACHABLE
ROW BOAT MOTOR